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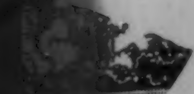

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Sending Motor Coach Repair Work to Outside Shops

THE repair garage of a company that operates a fleet of 120 trucks, 75 of which are in railway service, was recently visited, much to the surprise of the observer, it was found that there was no machine shop included with the garage. The superintendent of maintenance quickly explained the lack of a machine shop. The repair shop is located in an industrial section of a large city where many outside specialist shops can be quickly reached. A visit to these outside shops revealed that they were adequately equipped and manned to do first-class repair work on short notice. Cost figures were obtained on doing such work as grinding a clyinder block, a crank shaft, doing lathe work and other necessary machine jobs. These figures were compared with the figures of a truck operator who had built and equipped a modern machine shop. It was found, after considering the interest on capital invested, fire insurance and all other direct and indirect charges, that the work could be sent out to specialist shops and a substantial saving effected. From an economic standpoint, the question as to whether or not a motor carrier should set up his own specialized department, is determined by the following conditions. Is the company so situated that is has access to modern specialist shops that can give quick delivery? Can the work be done better in the home shop or on the outside? Can it be done quicker in the home shop or on the outside? Can it be done cheaper in the home shop or on the outside? Each carrier, by giving careful attention to these points, can determine the scope of work that can be done at a profit in his own shop.

Reducing Motor Coach Spare Parts to a Minimum

THE value of the stock kept in the main stores department of a truck operator who owns 117 units is only $6,000. This is a surprisingly small amount of stock to carry to maintain so large a number of trucks. The location of the garage in a large city lends itself to a low stock inventory. The fact that any spare part required for the four makes of trucks operated by this company can be quickly purchased in the city does not make it necessary to buy parts in large quantities, thus needlessly tying up large sums of money. For example, one set of piston rings for each make of truck is carried in stock. When a set is used, a new set is purchased at once. It was determined that a single item could be purchased just as cheaply as if an order had been placed for a large number.

Mechanical Division Sessions Largely Attended

AT yesterday morning's session of the Mechanical Division, there were distributed about 450 sets of reports, indicating an attendance of at least that number and probably more. This attendance is in direct contrast with former meetings of that part of the convention handling the work of the former American Railway Master Mechanics' Association, when sometimes less than 100 members attended sessions to listen to and discuss reports on locomotive subjects. It would be difficult to assign the large attendance at the sessions this year to any one cause, but one thing to which it may be partially attributed is the growing importance to the railroads as a whole of a concerted study of locomotive problems. A factor of equal importance is that the amplification of the speakers' voices enables everyone in the hall to hear all that is said, and this is a prime essential to the retention of their interest.

A Reliable Facility— Why Not Use It?

THIS year's report of the Committee on Automotive Rolling Stock contains information of more than usual significance to every mechanical officer, not only because of its relation to the problems of the mechanical department as an individual department but in relation to the whole question of railroad operation. In the information which the Committee has been able to secure pertaining to the serviceability and the reliability of the motor rail car, there is a remarkable tribute to this comparatively modern form

of transportation. Mechanical men, who through their entire railroad experience have dealt with the problems of the steam locomotive, can hardly fail to be impressed by the figures which are given dealing with the reliability of motor rail cars. To those who have devoted their efforts in recent years to the improvement of steam locomotive operation there should be food for a great deal of serious thought in the figures which indicate that under normal operating conditions the motor rail car may be expected to render service from 93 to 97 per cent of the time. As to the question of reliability one can hardly fail to be impressed, in comparison with steam locomotive operation, by the figures which indicate a performance of from 100,000 to 300,000 miles per delay or per engine failure. The summary of the report draws attention to the fact that the belief of the sub-committee is that the "serious failures of important engine parts have been reduced to a point where they cause no further serious concern."

There was a time not so many years back when many railroad men looked upon a railroad organization as being made up of several independent departments, the problems of which were to be dealt with on a departmental basis, and in all too many cases without any definite relation to the railroad as a whole. Today, fortunately, that condition of affairs is changed and the progressive railroad officer, regardless of the department with which he is associated, must deal with his problems not only as departmental problems but in relation to the road as a whole. The problem of the motor rail car in-so-far as the mechanical department is concerned has, since its introduction, been primarily a problem of maintenance in service. No doubt many mechanical officers have been reluctant to grant motor rail cars their proper place in the field of motor power—possibly in most cases because they were a comparatively unknown factor as compared with the steam locomotive. The mechanical department officer, even though his job may be primarily one concerned with the design and maintenance of motive power and rolling stock, is nevertheless indirectly concerned in the traffic and transportation problems of his road.

Without going into detail as to the reasons for the decrease in passenger traffic during recent years and without dealing with the problems of maintaining or increasing the passenger traffic, the mechanical officer is jointly concerned with the transportation officer in developing means at least to reduce the operating expense on unprofitable branch lines and local main-line passenger traffic. The experience of one road which has successfully operated motor rail cars for several years seems to indicate that it requires an average of about 2.6 locomotives to protect the same operation that may be performed by one motor rail car. The important fact is that the development of this transportation unit has provided the railroads with a facility that will enable them to reduce operating expenses in unprofitable territories. As yet many railroads in this country have had practically no experience with the operation of motor rail cars. By thoroughly acquainting himself with what has been done by other roads, the mechanical officer will be in a position to offer the transportation officer a satisfactory method of reducing operating expenses in unprofitable territories and, in addition, offer the traffic officer a possible opportunity of regaining a material percentage of passenger traffic in some territories that may have already been lost to other forms of transportation.

More Knowledge of the Locomotive Boiler is Needed

IT has been truthfully said that the remarkable increase in gross ton-miles per train-hour achieved in recent years is due largely to the improvements that have been made to the steam locomotive. Each year, the locomotive has grown in size and capacity and with each increase, heavier trains have resulted.

This growth in size has continued until recently when clearance and weight limitations made further increases impractical. However, instead of preventing further increase in power and economy, locomotives are now being designed and built that are setting the pace for still further and more intensive railroad operation. The modern locomotive, without increased weight on the drivers, is capable of greatly increased power output with a remarkable increase in economy of operation. The increase is impressive, especially with respect to the fuel economy.

A comparison of two locomotives of the same type, one of which was built in 1921 and the other a little over two years ago, shows an increase of nearly 60 per cent in horsepower output and a decrease in pounds of coal consumed for drawbar horsepower-hour of practically 48 per cent.

Approach to Problem

The railroads and locomotive builders have approached the problem of increasing the usefulness and efficiency of the steam locomotive from several different angles. But, all are striving for the same results—the production of maximum power with the lowest cost of operation. Certain fundamental principles of design are now followed by all the builders, such as high boiler capacity with relatively low combustion rates, economy in the use of steam, and refinement of design to increase power capacity and decrease the cost of maintenance.

We know that higher boiler capacity with low combustion rates demands a boiler with a large firebox and a large grate area. But what the relation of one to the other should be is a matter that, so far, remains unsettled. It was pointed out in the discussion of Lawford H. Fry's paper, which was presented during the Mechanical Division convention at Montreal last year, that very little was known about the relation between firebox volume and grate area and that an investigation would be very desirable to determine that relationship.

The Pennsylvania test plant at Altoona, Pa., has provided much information bearing on the proportioning of locomotives which has been effectively used, not only by the Pennsylvania, but for the benefit of other railroads as well. The lack of a test plant of its own, however, need not deter any railroad from making road tests of its new power, from which may be secured much of the data necessary to determine the most effective proportions of the locomotive boiler. A final solution of this problem, such that a boiler may be completely proportioned by formula, will probably never be reached, but progress in that direction will undoubtedly be made at a rate proportionate to the amount of data accumulated as the result of tests—both those conducted on the test plant and those conducted on the road.

Electric Rolling Stock Report

THE report of the commitee on electric rolling stock, presented Friday, is an imposing encyclopedia of information on railroad electrification. Particularly commendable are the parts of the report which appear as Exhibits 1, 2, and 3. In Exhibit 1, excellent progress has been made toward establishing a standard method of rating electric locomotives, by means of which one locomotive may be compared with another. Exhibit 2 explains the fundamental causes of insulation failure in such simple language that almost anyone can understand it; this information should help materially in preventing damage to electric locomotives by improper use and improper maintenance. Exhibit 3 deals in the same lucid manner with the subject of lubrication of electric locomotive bearings.

The remainder of the report contains much good information, but the folded inserts indicate that more energy was expended in collecting information than in pulling it in to easily usable form. The report includes 36 folded inserts giving data on locomotives in service throughout the world. Practically the same information is collected by the American Electric Railway Association and was first presented on two large charts and later as printed tables on standard size report pages.

The National Electric Light Association also receives a report each year from its committee on electrification of steam railroads. Because of the character of the work done by its committee, the association has engaged the services of a permanent secretary who devotes most of his time to electrification committee activities. This fact is not presented for the purpose of inferring that the Electric Rolling Stock Committee of the Mechanical Division should employ a permanent secretary, but rather to indicate the magnitude of the work involved.

In two respects the Electric Rolling Stock Committee and the N. E. L. A. committee are duplicating each other's work. Both sum up the progress which has been made in electrification during the year. Both also present studies of electric traction as applied to individual railroads and apparently intend to continue the practice from year to year. A summation of the year's activities is a logical practice for any report, but it would seem that collecting the data twice might be avoided. Duplicate studies of individual roads may possibly be justified on the basis that the A. R. A. study is made by some one connected with the road in question and the N. E. L. A. study is made by an independent investigator who has not been connected with the project being studied.

The major part of the text of the Committee on Electric Rolling Stock report is prepared in such simple language that the reader does not need electrical training to understand it. It is apparently written for the average railroad reader. On the other hand, among the many inserts are complicated wiring diagrams, which even an electrical engineer can not understand unless he is familiar with control circuits and control-circuit nomenclature.

The information on electric traction must necessarily originate with the railroads. The American Electric Railway Association representing electric railways and the National Electric Light Association, representing public utility companies, also have logical interests in the subject and are doing excellent work in gathering and compiling information. A brief review of work finished and work in progress indicates that more headway could probably be made with less effort and expense by having representatives of the several committees working on the subject get together for the purpose of sorting the information already available, boiling it down and agreeing on a plan of action whereby each could contribute to the general fund of compiled data without unnecessary duplication of effort.

Today's Program

THE entire day has been set aside by the Mechanical Division in order that the members may have time to view and study the exhibits. These include not only the exhibits on the Million Dollar Pier and in Marine Hall, but also the track exhibits at the Reading and Pennsylvania Railroad terminals. Adequate bus service is available between the Million Dollar Pier and these track exhibits. The next session of the Mechanical Division will be on Monday morning.

Motor Transport Division

A meeting of the Motor Transport Division will be held in the Rose Room, Hotel Traymore, at 10 a. m., daylight saving time. It will be in the nature of a joint conference with representatives of the automobile industry, for the discussion of matters of mutual interest.

R. S. M. A. Annual Meeting

The annual meeting of the Railway Supply Manufacturers' Association will be held in the Convention Hall, or Greek Temple, at the ocean end of the Million Dollar Pier, at 11.30 a. m., daylight saving time.

District meetings for the election of new members of the Executive Committee in Districts 2, 3, 4, 7 and 8, will be held in the R. S. M. A. executive committee room at the shore end of Assembly Hall, between the hours of 10 and 11 a. m., daylight saving time.

10.30 a. m. Orchestral Concert, Entrance Hall, Million Dollar Pier.

3.30 p. m. Orchestral Concert, Impromptu Dancing, Entrance Hall, Million Dollar Pier.

9.00 p. m. Canadian Night in the Ball Room of the Million Dollar Pier. Special Features, "Miss Canada," Miss Viola Smart, Canadian National Railway. Caledonian Pipe Band Kilties, Sword Dance. "Special"—A. McGowan, Canadian National Railway.

Sunday's Program

A Sacred Concert will be held on Sunday in Entrance Hall on the Million Dollar Pier at 3.30 p. m., daylight saving time. This is the first time this event has been held on the Million Dollar Pier, and a special effort has been made to provide the attractive program which follows:

1. Orchestra .... *Selected*
2. Quartette—Song of the Jolly Roger .... *Candish*
3. Trio—Serenade .... *Drego*
4. Tenor Solo—"Not Understood" .... *Haughton*
5. Cello Solo—The Swan .... *Saint-Saens*
6. Quartette—Sunset .... *Van Der Water*
7. Harp Solo—Mighty Lak a Rose .... *Nevin*
8. Duet—The Crucifix .... *Faure*
9. Violin Solo—Minuet in G .... *Beethoven*
10. Bass Solo—The Blind Plowman .... *Clarke*
11. Trio—La Paloma .... *Yradier*
12. Quartette—Your Land and My Land .... *Romberg*

13. Quartette—Travelin .... *Goodwin*
14. Trio—Serenade .... *Toselli*
15. Orchestra .... *Selected*

The quartette numbers will be rendered by the Pennsylvania Railroad Red Arrow Quartette, the members of which are I. D. Schaffer, R. M. Gibb, C. W. McVicker and J. F. Donaghy.

The Nicoletta Symphonia Trio includes: Harp, Frank Nicoletta; violin, Jack Simkins; cello, Benjamin Gusicoff. The members of the trio are all members of the Philadelphia Symphony Orchestra.

The orchestral numbers will be furnished by Fry's Million Dollar Pier Orchestra, under the personal direction of Charles Fry.

Mrs. Edward Laterman who for many years attended conventions with her father, James C. Currie, who represented the Nathan Manufacturing Company up to the time of his death, arrived yesterday and will sing at the Sacred Concert. Mrs. Laterman as Miss May Currie sang regularly for the conventions at Saratoga.

Engineering Meeting

THE Board of Direction of the Engineering Division, A. R. A., will hold a meeting at the Hotel Strand, Atlantic City, June 27. The members of this board are also officers of the American Railway Engineering Association.

Enrollment Hours

THE Enrollment Committee will keep the registration booth open today from 9 a. m. to 12 m., 2 to 5 p. m., and 7 to 9 p. m. On Sunday slightly different hours will be observed, the booth being open from 10 a. m. to 12 m., 2 to 4 p. m. and 7 to 9 p. m.

D. C. Hitchner Dies

D. C. HITCHNER, president, H. B. Underwood Corporation, Philadelphia, who had expected to be at Atlantic City during the conventions and exhibit, died suddenly early this week at his home in Philadelphia. Mr. Hitchner has been a regular attendant at these conventions for many years and his loss at this time is keenly felt by his associates and many other friends.

The Entertainment Yesterday

YESTERDAY'S social affairs consisted of an orchestral concert in Entrance Hall in the morning, an informal dance, with tea at four in the afternoon, and a concert between eight and nine o'clock in the evening by the Reading Company Seashore Band, under the direction of John L. Snyder. This was followed by an informal dance and cotillion. Convention attendants of earlier years were glad to see this delightful, gay function reinstated.

The cotillion was under the direction of H. T. McConnell, Chicago. For the marked success of the evening's entertainment, credit is due to the Entertainment Committee in general and to the sub-committee in charge, as follows: J. H. Cooper, chairman; J. W. Coleman, vice-chairman; J. R. New, W. G. Krouser, J. W. Hulson, O. C. Hayward, Cyrus Hankins, C. T. Ressler, R. R. Paradies, L. P. Pratt, F. O. Schramm, E. A. Thornwell, R. P. Townsend, A. L. Roberts and C. Beaumont.

Registration Figures

AT four o'clock of the third day the total attendance was 5,798, compared with 5,690 in 1926. Below is given a table of comparison for the past five conventions. In 1926 the car subjects were discussed during the first three days of the Mechanical Division meeting; this group always attends in larger numbers than the locomotive group. We may therefore expect a big attendance of mechanical men next week.

	1920	1922	1924	1926	1928
Mechanical, Division V	666	554	772	940	836
Purchases and Stores, Division VI	37	26	21	450	477
Motor Transport, Division VIII					41
Railroad guests					264
Railroad ladies	413	421	607	745	794
Supply men	1935	2015	2300	2615	2419
Supply ladies	649	432	546	600	646
Special guests	285	276	419	340	22
Complimentary					299
	3985	3724	4665	5690	5798

Motor Truck Operation Discussed by Division VIII

MOTOR truck, tractor and tractor and trailer operation by the railways or in competition with them was the subject of the second day's meeting of the Motor Transport Division at the Traymore yesterday. G. C. Woodruff, chairman of the Motor Truck Section of the division, presided throughout the day, and marked interest in the subject matter was displayed by the members in attendance.

The convention heard first a series of brief discussions of conditions in the various regions of the country with respect to truck operation by the railways and to competitive trucking services. C. J. Chenworth (A. C. L.), J. G. Drew (M. P.), E. W. Lollis (C. M. St. P. & P.), G. L. Whipple (U. P.), M. F. Steinberger (B. & O.) and James L. Hill (L. I.) spoke for their various regions.

Just prior to adjournment for luncheon, suggestions were received as to the regional partition of the division. It was the consensus that Canada should not be assigned in its entirety to Region No. 7, comprising the northeastern section of the United States, but should be divided and included in the various regions bordering Canada. The General Committee will officially act upon this matter at a later date.

At the opening of the afternoon session, J. B. Fisher, general superintendent of transportation of the Central Region of the Pennsylvania, described the motor truck operations of his railway. Mr. Fisher was followed by Mr. Woodruff, who presented a similar description of trucking activities of the New York Central Lines. Following brief discussions of motor truck operation by the railways directly as compared with such operation under contract, by J. G. Drew (M. P.), and of the attitude of state commissions toward railway operation of motor trucks, by Mr. Steinberger (B. & O.), the meeting adjourned early in the afternoon to permit delegates to the convention to visit the exhibit of motor transport equipment in Marine Hall and on the Million Dollar Pier.

The meeting today will be thrown open to representatives of the automotive industry and all others interested in motor transportation for an open discussion of matters of mutual interest. A large attendance is anticipated.

Division VI Elects Officers

As a result of the election held yesterday, the Purchases and Stores Division, by unanimous vote, chose C. C. Kyle, purchasing agent, Northern Pacific, for chairman, and William Davidson, general storekeeper, Illinois Central, vice-chairman, and re-elected W. J. Farrell, secretary. The retiring

C. C. Kyle, Chairman Elect

chairman, A. S. McKelligon, general storekeeper, Southern Pacific, Pacific System, and the following officers were elected to the General Committee: F. S. Austin, purchasing agent, Boston & Maine; J. L. Bennett, purchasing agent, Central of Georgia; G. W. Bichlmeir, general purchasing agent, Union Pacific; C. B. Hall, stores manager, Pennsylvania; L. C. Thompson, manager of stores, Canadian National; and C. E. Walsh, purchasing agent, Pennsylvania.

The division has again chosen to bestow its honors upon men who have distinguished their connection with the division by an active participation in its work, and, the division has in both instances selected men who have virtually pulled themselves up in railway work by their own bootstraps.

The Chairman-Elect

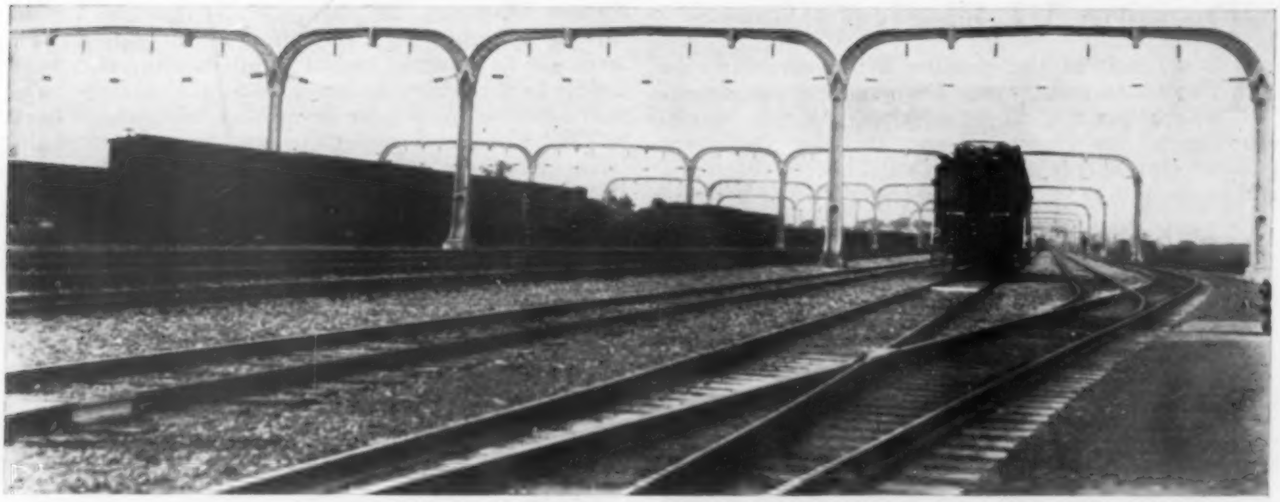
Mr. Kyle was born on November 25, 1872, in the little village of Lowell, Wis., which never had, and probably never will have, a railroad. He is proud of his colonial ancestry, which, interestingly enough for a railroad officer, hailed from a town (Lewis, N. Y.) which also cannot be found on a railroad map, though 150 years old. Mr. Kyle is thankful for receiving a high school education when high schools were not so plentiful and of supplementing that with a year in a business college.

His first employment in railway work dates back to 1892 when he entered the law department of the Great Northern as a clerk and stenographer. In 1893 he went to Brainerd, Minn., as a stenographer to the master mechanic of the Northern Pacific, soon after being promoted to chief clerk. He was transferred to St. Paul, Minn., in 1906, where he was chief clerk of the mechanical department until 1916 when he was appointed superintendent of the general office building. He served in that capacity until 1921 when they made him general storekeeper of the Northern Pacific. Though young in the stores work, he adjusted himself quickly under the counsel of H. C. Elliott, and won the advancement to purchasing agent, August, 1926.

As general storekeeper, Mr. Kyle adopted the practice of being on the road about one-third of the time, traveling about 40,000 miles a year which brought him into personal contact with every employee in the stores department and gave him a wide acquaintance in the other departments, where his radiant optimism and cheerfulness always made friends. In the affairs of the division he was also active, and it was only regretted that illness prevented his being present to receive the announcement of his election.

W. Davidson, Vice-Chairman Elect

(Continued on Page 1490D25)



Mechanical Division in Third Session

Address by A. G. Pack and Continuation of Discussion of Report on Locomotive Design and Construction

THE meeting of the Mechanical Division was called to order at 9.30 yesterday morning. The address of the day was made by A. G. Pack, Chief Inspector of the Bureau of Locomotive Inspection, Interstate Commerce Commission. The discussion of the Report on Locomotive Design and Construction was continued from Thursday's session. The first part of the discussion was reported in the *Daily* on page 1420D131.

A. G. Pack Makes Plea for Greater Safety

Congratulates the Mechanical Division on its high standards, its accomplishments and opportunities

Some time ago I saw on display an exhibit depicting the evolution of railroad transportation. It attracted my attention because it contained this significant statement; "The locomotive is the most vital element in railroad operation." It never occured to me to challenge that assertion, for the reason that the mere statement seems equal to a demonstration.

The president of a great railroad system recently said in a public address that "No railroad can be better than its motive power. Without adequate and well-conditioned motive power it is impossible to operate economically or satisfactorily, and to give service to the public which is the duty of each and every one of us."

Many Eventful Periods in Locomotive History

We are near the close of the century since the first steam locomotive was placed in successful operation. Looking backward through the vista of years, the record reveals the struggles, the failures, as well as the achievements of the most eventful periods in history.

Motive power has passed through at least three important stages or periods of development: the primary stage or period of outlines and of discoveries; the second stage, or period of inventions and the substitution of the locomotive; and the third stage, or period of regulation and standardization.

Important events have followed in rapid succession. The right to navigate waters embraced the right to control commerce. The power to regulate commerce and the means, agencies and instrumentalities by which it was moved, had not been defined in the early history of our country and was not well understood. Exclusive rights were granted by some of the states and denied by others. The steamboat that was licensed in one state was refused a license in another. Facilities for transportation on the waters were monopolized, obstructed and threatened with destruction. Congress enacted a law to license boats engaged in the coasting trade of the United States. This law came into collision with the laws of the states that had granted exclusive privileges. In 1824, in the case of Gibbons vs. Ogden, the Supreme Court of the United States held that the power of Congress to regulate interstate commerce includes the right to regulate or license the vessel or means by which it is moved; that when Congress manifests an invention to occupy the field of legislation on the subject, its laws are supreme and all state legislation is precluded. Later, in the case of the "Daniel Ball," the Supreme Court held that the power given to Congress authorizes all appropriate legislation, whether that legislation consists in requiring the removal of obstruction, in prescribing the form and size of the vessel, or in subjecting the vessel to inspection and license in order to insure its proper construction and equipment. These decisions paved the way to end the conflict of legislation, and laid the foundation for uniform regulation and development of a complete and effective transportation system.

The invention of the steam locomotive was the final word in railroad transportation. It took time to ascertain its full meaning and the extent of its possibilities. The transition from the horse to the steam carriage, from the turnpike to the railroad, was not a sudden leap from the one to the other, but a slow and steady growth. To have changed from the one system to the other without thorough study and careful deliberation, would have been a disastrous transformation. The mechanical world was unprepared for such a radical change. The most sanguine, as well as the most advanced and skillful among mechanics, had to pass through a period of apprenticeship and experimentation, with no recognized masters of the art or qualified experts to train them or to guard against the pitfalls of failure. Like the new machine, which was then in the process of development, the early experiments were necessarily exceedingly crude. Many of them now would be considered ludicrous and uncomplimentary to the art or science of mechanics in its present stage of development. One of the things that may be prominently noted was the common belief that the locomotive would not stick to the track; and in no event could it move up grade with a load without some mechanical device to prevent it from slipping back. The highly important element or principle known as friction had not been discovered or developed, and its discovery eliminated many of the fears and doubts regarding the efficiency and practicability of the steam locomotive. With its discovery the crude locomotive whose successful trips had to be guaranteed by relays of horses along the way, not only developed into a self-propelling unit, but has since become the most powerful agency in the movement of traffic and commerce.

Possibilities of the Locomotive Unappreciated Even in Later Years

When the locomotive had reached that stage of development that its mechanical efficiency and success was certain, its use was still indefinite. Railroads equipped with the new motive power aroused the powerful opposition of vested interests represented by turnpike, canal, bridge and stagecoach companies, by state governments which received revenue from canals, by tavern keepers, and even by farmers who saw the market for horses, hay and grain seriously impaired. All this opposition had to be overcome.

While it is a matter of history that Stephenson's Rocket made several successful trips in 1829, and the first American-made locomotvie commenced operating on the Charleston & Hamburg Railroad in November, 1830, and it was then realized that the locomotive would definitely displace horses as a motive power on railroads, yet within the period of ten years, from 1830 to 1840, there had been built and was in operation only 3,000 miles of railroad in the United States.

The Civil War Period

The fifty-year period commencing in 1840 and ending in 1890 was one of great railroad development. The Civil War intervened, and to a certain extent retarded progress, especially in railroad construction. Immediately after the close of the war in 1865, a new era of internal improvements commenced.

Young men, among the flower of the nation, abandoned other occupations to engage in railroading. The then known hazards of the occupation did not deter them. As representative of the chivalrous, adventurous and forward-moving spirit of the age, they volunteered their services in the new and growing enterprise. It was an employment that afforded the opportunity to travel, in connection with a quasi-public service which was considered responsible and dignified, and which gave more or less distinction and well-deserved prestige to the employee. It had then, and still has, a fascination that combines thrills of excitement and responsibility with all the other extraordinary tests of skill, courage and endurance so essential in strong and active manhood.

For the most part the danger was considered a mere incident of the employment. If injury or death resulted, under the doctrine of assumed risk, there was no fixed or definite liability. There were either no minimum requirements or a general lack of uniformity; and the standards of safety, if any, were only such as conformed to the varying notions and opinions of operating managers who as a rule were not mechanics, and adopted economy and expediency as the poor substitutes for, and at the expense of, safety and efficiency. The rule that the greatest efficiency can only be attained through a correspondingly high standard of safety, was not generally recognized or observed. Accidents were numerous and the death rate was appalling. Hundreds of lives were annually unnecessarily sacrificed. Statistics are not complete covering the earlier periods. In 1850 the American Railroad Journal reviewed the report of a coroner's jury and affirmed that there was no excuse for such frequent accidents; that railroad corporations could prevent them by use of proper equipment and material. In 1899 one death occurred for each 357 employed in connection with railroad operation, and one was injured out of each 35. Even in the year 1906 one death occurred for each 387 employed.

The Beginning of the Movement for Increased Safety

Prior to the passage of the Boiler Inspection Act in 1911, safety legislation had covered only a limited field. The wholesome effect of the enactment and enforcement of this law at once became apparent. Five years after it went into effect and during the year 1916, only one was killed for each 631 employed, and after its enforcement in connection with other safety laws for a period of 14 years, during the year 1925 only one out of 1,118 was killed accidentally. Not only has safety been promoted, but there has been a corresponding increase in the efficiency of locomotive equipment.

The first year after the law went into effect, inspection showed that 67 per cent of the locomotives were defective. In 1927 inspections showed only 31 per cent defective. In 1889 there were 29,036 locomotives in use on 153,385 miles of railroad, and the locomotives moved 1,041 ton-miles of freight per capita of population during the year. In 1925 there were 70,361 locomotives in use on 250,000 miles of railroad, and the locomotives moved during the year more than 4,000 ton-miles of freight per capita of population.

The modern locomotive is a monster unit of equipment, a giant and complex mechanism of numerous parts, artfully and scientifically designed, constructed, adjusted and related to develop, conserve, retain and combine a maximum of power and safety.

Railroad transportation has now reached that stage of development, both in regulation and operation, where the mechanical department is a most important factor, requiring the services of the best-trained, experienced, expert, skillful and efficient operatives.

The Importance of the Mechanical Department

The department ought to be what the name implies. I include in and as a part of the mechanical department the men who work, as well as the men who manage or direct

the work. The officer in charge of mechanical operation may be ever so efficient in management, but he cannot succeed alone. He must have facilities and supplies. He must have the co-operation of the shop superintendent, the foreman, the master boilermaker and the master mechanic. He must have the support of the shop mechanic, the boilermaker and each helper on the job. There must be system, team work and application. The men who keep the locomotive in condition for service are the silent factors in train movement. Efficiency and safety bear testimony for or against them. A silent worker is often the most eloquent advocate of the department, because his work speaks for the whole organization. Every successful trip of a locomotive is a boost and each failure is a warning.

The mechanical department of a railroad system is more than the locomotive keeper. It ought not to be satisfied with static conditions. When an imperfect or defective condition comes to its knowledge, it should not be content with mere repairs alone, but should endeavor to ascertain the cause and to take the necessary measures to prevent a recurrence. It should at all times strive for a higher standard of efficiency and safety. It must be in the vanguard in locomotive improvement. It should not wait to be told of modern appliances or betterments, but it must know of and apply them.

This does not justify reckless experimentation. Safety should be the first and last consideration. If a kind of material, a method of repair, a type of construction or equipment is defective, uncertain, or of doubtful economy or durability, it should be discarded. Doing a thing in a doubtful manner, leaving it entirely as the subject of tests in actual use, will bring disrepute to the organization and discredit the whole system if it results in failure or accident.

The great bulk of modern standard locomotive equipment has now reached the stage of development and perfection where it is no longer dubious or uncertain. Its safety of material, design, construction and operation is not generally a matter of test in actual service, so that application may be excused on the ground that it may prove only a costly and dangerous experiment.

Scrap Obsolete Equipment

A prominent railroad officer very recently confirmed what I think is now the consensus of opinion not only among the railroad operators but in the public mind, when he said: "One of the things which has been most effective in our national progress has been the courage with which we have scrapped obsolete tools, replacing them with larger and more modern devices—the courage with which we have torn down small and inadequate buildings and erected fine and properly equipped buildings in their places. What is good practice for an everyday householder, merchant and manufacturer is just as truly good practice for the railroads."

Mechanical departments of railroads are now generally well-equipped, standardized and efficient. They have also, either voluntarily or involuntarily, become an important part of the regulatory system. Dereliction is the exception rather than the rule. There is generally a sincere and earnest co-operation for the betterment of the service and safety of equipment. This co-operation extends beyond the mechanical department into various departments that have to do with locomotive inspection, equipment and operation. It is a matter of supreme gratification to know that we have this co-operation, and that our purposes and methods of inspection are now better understood than ever before. Government inspectors are interested in safety and not in management, and are proud of the record that has been made.

The time has passed when the duty to make improvements may be avoided or delayed on the ground that we are still experimenting and that it is better to keep what we have, even though it is obsolete. The carrier that refuses or neglects to improve its equipment does not belong to the present age. By so doing it voluntarily subjects itself to the penalties provided by law, if not the penalty of elimination provided by competition. It is true that there are yet a number of small carriers whose ability to acquire locomotive equipment is limited, but most of these carriers are earnestly endeavoring to comply with the law in the maintenance of such equipment as they have.

Some of the larger carriers permit use on their lines of equipment owned and operated by smaller carriers. The courts have held that train movements on highways of interstate commerce are not independent of each other. It matters not as to the ownership or operation of a locomotive, if its use is permitted on a highway of interstate commerce, it cannot be considered as independent in point of movement and safety, but interdependent, for whatever brings delay or disaster to it, or results in disabling one of its operatives, is calculated to impede the progress of other trains and imperil the lives and limbs of their employees and the traveling public, and the carrier over whose line it operates is responsible for its use. It, therefore, becomes the duty of each carrier, as part of the great railroad system of the country, to co-operate to the end that all locomotives used on its line may be properly inspected and safely equipped and maintained.

The system of safety regulation adopted under the law is not intended to dictate specific devices or mechanical appliances, but to fix the standard or minimum requirements, of material, construction, design or type of device or appliance, necessary to protect and safeguard life and limb, and as a condition precedent to the use of the locomotive, leaving the carrier free to choose suitable equipment.

Ignorance of the Law Is No Defense

Our courts have held that the duty of the carrier to keep its locomotive safe and suitable for use is continuing and absolute. Regular inspections must be made. Tests at regular intervals are necessary. Records of the locomotive, its tests and inspections, must be kept and reported as required by the rules. Locomotive equipment must meet minimum requirements. The fact that a government inspector has not approved or disapproved a test or method of inspection, condition or type of locomotive equipment, or that the carrier had no knowledge or notice of the defective or unsafe condition, or that there is no rule covering the condition, the appliance or device that proves unsafe, will not relieve the carrier of its duty to keep its locomotives safe for use so that life and limb may not be unnecessarily endangered.

It is the duty of the government inspector to see that the carriers comply with the law. The inspector co-operates and shares responsibility with the mechanical and operating departments and the warning that he sounds may prevent accident, safe life, or protect from injury. "An ounce of prevention is often more effective than a pound of cure."

It is now generally conceded that complete development includes all the essentials of industry, labor, and capital; the methods and means of communication and intercourse; the facilities for traffic, commerce and distribution; organization, and management; the conserva-

tion and correlation of forces necessary in all its progressive stages; and finally, a system of regulation to protect the lives and limbs of those engaged.

Transportation is one of the highly specialized and important subjects of commerce, but it is not an isolated or exclusive occupation. Its function is quasi-public. It is a component and essential part of the great social, economic, and industrial system of the country.

The railroad is one of the great divisions of the transportation system. It is a monitor of progress and commercial independence. It is the index figure on the invisible hand that holds the background of a nation's wealth, its prosperity and its civilization.

Show me the railroads of a country and I will tell you something about the country. Show me the locomotives that operate on the railroads and I will tell you more about the country.

I congratulate the Mechanical Division of this association on its high standards, its accomplishments, its opportunities. Let us collaborate and co-operate to the end that the locomotive may be not only the most vital element, but also a safe element, in railroad transportation.

Discussion

Advantages and Disadvantages of Boiler Pressure Higher Than 200 lb.

H. D. Webster, (B. & L. E.): One of the paragraphs says: "It is undesirable to introduce the complications of compounding except as it becomes imperative in connection with the use of ultra-high pressures." I didn't know what ultra-high pressures meant until we got over towards the last of this report of the subcommittee where it said that the Buchli locomotive referred to is of special interest at this time, representing as it does the simplest possible conception of an ultra-high pressure locomotive. And then down in the table below that it says, on the left-hand side: "Buchli, 850 lb. boiler pressure." So I wish to question whether it is really undesirable to introduce compounding except for such pressures, for instance, as 850 lb. The Baldwin Locomotive No. 60,000, which is on exhibition here now, and was here two years ago, is a three-cylinder compound locomotive and I understand that the results from it indicate that it is desirable to introduce the complications of compounding.

A. H. Fetters, (U. P.): The committee preparing this report has no specific objections against compounding in locomotive practice. There has been too much of it done in the last 30 years. But the thought intended to be conveyed in this paper was that if ultra-high pressures, especially accompanied by superheating, could be handled in single expansion, it would be manifestly wrong to introduce another expansion requiring additional cylinders.

As stated in this paper, Dr. Buchli has been able successfully to handle pressures of 850 lb. in single-expansion cylinders. His method of doing it has not been tried in this country. It consists in using the uniflow principle poppet valves for admission, the steam exhausting at a port in the center of the cylinder uncovered by the piston in its advance. But I happened to see some of Dr. Buchli's tests about a year and a half ago in Switzerland, and he was getting very good results at that time. There was sufficient superheat in the steam to prevent recondensation, even after the long high rate of expansion.

The engine is removable. It is like an automobile motor. The cylinders are about 8 in. in diameter by 12 in. stroke, three cylinders, high pressure, and the entire unit could be removed from the engine and another unit could be removed from the engine and another unit substituted in case of trouble, being demountable in the front end, and geared down to a jack shaft which, in turn, was connected with the drivers.

(A motion was carried to accept this section of the report.)

The Oil-Electric Locomotive in Railroad Service

Mr. H. E. Bergstrom, (N. P.): I move that the report of the committee be incorporated in the proceedings and the committee continued.

(The motion was carried.)

Back-pressure and Initial-pressure Gages, and Cut-off Control

Mr. W. L. Bean, (N. Y. N. H. & H.): I move that the section of the report be adopted.

(The motion was carried.)

Spring Plant of the Baltimore & Ohio

T. W. Demarest, (Penna.): We are all very much interested in the cost of locomotive repairs. A great many of us have reached the point in maintenance expenses where, in order to further reduce them, we must adopt constructive measures. By that I mean that we must present to house and back shop people the design of material and construction that is going to permit the detail of live between general repair, if it is practicable. One of the things that bothers all engine house foremen is the question of driving spring, engine-truck and trailer-truck spring failures and spring renewals. If you can take that load away from them you can make some payroll savings and reduce your expenses. We all know that in any spring we have the question of the chemistry of the steel, the question of its treatment through the shop and the resulting service effect. The paper in reference to the method of treatment is an important one. Before you can take any treatment as being the answer to all of your troubles, you will have to go to each one of your spring designs in detail and, from a record of the type of failure, establish whether or not your failures are produced by design or by method of manufacture.

The B. & O. has gone into this question in detail and Mr. Purcell, of the Sante Fe, has been engaged in this investigation for perhaps a year and a half. In our own effort to improve spring performances we first started out to analyze the types of failures by spring classes, in addition to looking into our methods of manufacture.

We find that our troubles are not due particularly to leaf bands. Our troubles from springs losing their set are not particularly severe. We have trouble with broken leaves and we find that two-thirds of our leaf breakage takes place in the three outside leaves, top and bottom; the intermediate leaves represents only one-third of our total leaf breakage.

If we can determine what causes the leaf breakage against the top and bottom of the band, we can reduce the springs going through our spring plant by one-third. There are some other interesting questions, and that is in reference to the question of nibbing leaves to hold them. Perhaps one large central nib, instead of a number of nibs, would be helpful.

I assume that Mr. Cromwell will agree that his temperatures, initial heating and drawing temperatures will be regulated by the chemistry of the steel; that the figures he has given you for temperature represent the figures for use with the steel used by the B. & O.

C. T. Ripley (A. T. & S. F.); We came to the same conclusion a number of years ago that springs were one of the weakest links in locomotive construction.

If automobile springs were as crudely made as railroad locomotive springs, none of us would take any long tours with automobiles. As Mr. Cromwell states, the lack of refinements means the greatest amount of irregularity, and that is largely conducive to this extra work in the roundhouse which Mr. Demarest has reference to.

Our study soon showed that the nib was a frequent cause of leaf breakage. If you will cut a new leaf through at the nib and etch it, you will find there are small cracks started immediately. Our latest practice is to eliminate the nib completely and put a crimp on either side of the leaf. That has been found to be very helpful. It may not meet all requirements, but in our service it has undoubtedly been helpful.

Leaf bands have been a source of much trouble to us. Our main way of getting around that has been to increase the band, increase the pressure with which it is applied, and in many cases use cast-steel bands. A better banding press was necessary. In fact, all of the equipment in railroad spring shops has been somewhat antiquated and insufficient to handle the big springs we are now using in locomotives.

The next step is to use alloy steels in certain classes of springs; but the question you run up against immediately is, when these springs come back to the shop, how are you going to know which are alloy and which are carbon steels. It is possible you can get the leaves in our alloy springs rolled with a special edge, so that it will be recognized immediately, the shape of the edge being somewhat different from the ordinary round edge.

Alloy steel is not necessary in all springs, but we have some places, such, for example, as in some of our six-wheel tender trucks, where your space is very restricted, and alloy steel, in spite of its high cost, may be a necessity.

The design of the spring itself is essential. That is a rather large subject, and all of the different springs involve different problems. In general, I think the multiplication to more and thinner leaves gives a better spring in certain services. In other cases it is a matter of how many heavy leaves you may use at the bottom of the spring.

The worst problem, and the one that no one has even approached, is the coil spring. We have made but very little progress in that. The drawback in oil does not work on the coil spring. Apparently the section is such that you do not get the penetration. The result is you are very much disappointed in all of the experiments you may make, and a lot of research work is very much needed by the railroads on this subject.

O. C. Cromwell, (B. & O.): Before we started redesigning furnaces, we looked around and found out the Santa Fe was interested, and we collected some of their experience. The thing that impressed us the most was the success they obtain from automobile springs, and when you dig into that you find they get the analysis of the steel first, they find the steel they are going to use, they fit the treatment to the steel, and then they have automatic control of their temperatures.

The study that we made of the failure of springs did not show any particular class that have given us trouble but probably we did not cover all the types of spring that we had in service. But the investigation indicated that it was not so much the design of springs; it was the treatment. That led to a close observation of the manner in which they were conducting the work in the spring plant. You will find out that plates vary in the temperatures throughout their length and it is perfectly natural if you attempt to treat a plate at varying temperatures you are going to have different stresses in the plate. When you remove the spring after it is heated, you must plunge it into the quenching bath as rapidly as possible. You will be surprised how quickly the temperature drops. Your quenching oil must be in circulation so as to keep the temperature down.

After you get through with the assembling you paint the spring. A little oil will preserve it and prevent it from rusting just as well as a coat of paint and it lubricates the plates.

The question of the heat treatment is one that has been given considerable study in the manufacturing world and it is of vital importance. We have not only taken care of this one point, in connection with the manufacture of springs, but we are spreading it over in other parts of our manufacture.

In railroad service forgings or locomotive parts may be manufactured at a builder's plant or in your own shop, that will need attention in some other shop than the one in which it was manufactured. It is important to find some way of marking the steel so that, when the other man gets it for repair, it would indicate to him the temperature at which the steel should be handled.

(*A motion to accept the entire report was made and carried.*)

Committee Report on the Lubrication of Locomotives

Mechanical lubrication of guides—Pressure greasing of shoes, wedges and hubs—More study needed

G. W. Ditmore
Chairman

The Committee on Lubrication of Cars and Locomotives has made some study of the subject of locomotive lubrication and in this report has only attempted to cover the subject in a general way for the purpose of developing available information.

Cylinder and Valve Lubrication

A study has been made of the various methods employed; namely, (a) the hydrostatic lubricator with single or double system of piping is in most common use; (b) the force feed or mechanical lubricator is being used extensively.

It has been found that the mechanical lubricator has a distinct advantage, in that it provides more efficient feeding of oil to valves and cylinders, thereby prolonging the life of valve rings, valve bushings, piston rings and piston bushings. To obtain economy in the amounts of oil consumed as compared with hydrostatic lubricators, on locomotives operating in territories where the demand on the locomotive varies, it is necessary to provide a variable feed through proper connection of the ratchet-lever connecting rod in order that as the cutoff is lengthened the amount of feed per revolution of the driving wheels is increased.

Side and Main Rod Bearings

A number of lines are now experimenting with a pressure system for side and main rod bearings and motion work lubrication. Reports indicate this system has so far given satisfactory results and is an improvement over the old style rod cup for crank pin lubrication, and oil for motion work.

Guides and Piston Rods

Light oil, fed by gravity, is most generally employed for guide lubrication.

Oil cups of proper design and oil of proper consistency are important factors in securing satisfactory guide lubrication.
Some roads are experimenting with connecting feeds from mechanical lubricators to guides thus lubricating them with valve oil. Reports received indicate this method has so far proved satisfactory and more efficient than the oil cup method.

Some lines have eliminated the piston swabs as they state that the piston rods secure sufficient lubrication from the cylinders. The objection made to the piston swab is, that the piston rod may be lubricating from the swab and indicates to the engineman that the cylinder is properly lubricated whereas the cylinder may not be, thus deceiving the engineman as to the true condition.

Engine Trucks

Engine truck journals, owing to their location, are difficult to lubricate but experience indicates that with proper attention to lubrication of the hub plates and periodical attention to packing of boxes, trouble with overheated engine truck journals can be reduced to a minimum.
Two general practices are followed in applying packing to engine truck cellars, viz.: placing the packing in rolls with the ends turned under or applying in one mass with the ends turned under. Either of these methods appears equally satisfactory.
A new departure in engine truck lubrication is now being experimented with in service, the design of the bearing being similar to that of floating bushings used in main rods. The bearing consists of halves bolted together, to flanges of which form the hub liner and which floats in the box.
A grease cup is installed on the truck box, and journal compound is forced to the bearing in a manner similar to that used on an ordinary rod cup.
The object of this experiment is substantially to reduce the labor necessary for giving intensified attention to engine truck cellars.
New designs of truck frames have been developed with outside bearings and boxes. Where these can be applied they are proving much more satisfactory than the old inside type bearing with cellar type boxes.

Experiments on several roads have developed that where oil holes are drilled straight through the top of engine truck brasses the tendency is for the oil to be forced back out through the top of the brass instead of following around the bearing. These roads have eliminated the holes and provided oil channels leading around the side of the brass so that any oil poured on top will flow into the cellars and then be fed from the packing.

Driving Journals

Grease is most generally used for driving journal lubrication. A majority of lines use a perforated plate with $\frac{5}{16}$-in. holes on road locomotives, and plate with $\frac{3}{8}$-in. holes on switch locomotives. These diameters of perforations were established several years ago with grease commonly used at that time. With the advent of heavy high-speed power, it was found necessary to develop what is termed "dehydrated grease," which is extensively used at present. This is because the old style grease caused trouble by incrusting next to the journal.

Some roads have found that this "dehydrated grease" feeds more rapidly than the old grease, and by reducing the size of the perforations from $\frac{5}{16}$-in. to $\frac{1}{8}$-in. and allowing a maximum of 50 lb. follower spring tension when the spring is fully compressed, the consumption of grease was materially reduced and also the trouble with the overfeeding of grease causing it to work out at the sides and ends of the cellars.
Improved design of driving box cellars providing for reduced contact surface of grease on driving journals is being used by a number of lines, the object being to reduce the consumption of grease.

The method for many years of providing shoe and wedge lubrication has been to cut grooves in the driving box or wedge and drill holes from oil pockets in the top of the box to the shoe and wedge faces. With the object to provide more efficient lubrication, some roads have removed the saturated waste, welded a plate over the oil pockets, applied a pressure fitting and are using a soft grease for lubrication. Reports from such roads indicate that this method has proved satisfactory. In some instances grooves have also been drilled from these pockets to the hub plates.
To prevent hot driving boxes resulting from driving brasses gripping the journals due to expansion, driving brasses should be bored sufficiently larger than the journals to allow for expansion.
The bottom edge of the driving brass should be chamfered to assist the feeding of the grease.
Some roads have found that economy results by turning all driving journals when a locomotive receives general repairs. The committee believes this to be good practice.

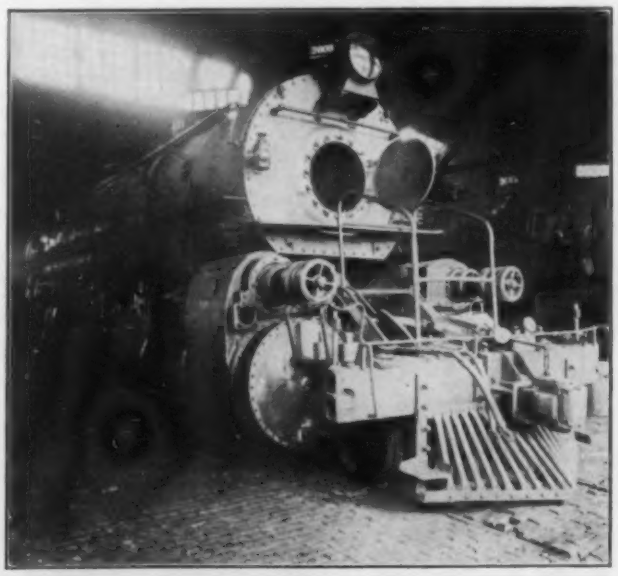
Hubs and Hub Liners

Efficient lubrication of hubs and hub liners is most essential for the satisfactory running of engine trucks, trailers, and driving boxes.
Past practice has been to lubricate these surfaces by pouring oil on them either at terminals, on the road, or both. The committee believes that this method is not fully efficient under present day operation.
Experiments have been made by some roads, by welding a plate over the oil pockets on driving boxes, connecting them to hub plates with an oil hole, applying a pressure cup in the top of plate and using a soft grease for this purpose. Reports indicate this method is substantially more efficient than the use of oil under the old method.

One road reports the use of heavy graphite grease on engine trucks and trailers, together with floating hub liners, to have materially reduced wear. A hole is drilled through the engine truck wheel hub and the grease is forced through this to the hub plates with a threaded plug similar to that used on rod cups. On the trailer boxes that were originally cored with oil channels leading to the hub plates, pressure cups have been applied to the boxes and grease is forced through the oil channels to the hub plates. The floating hub liners on both engine trucks and trailers are perforated so that grease forced to them passes through and lubricates both sides of the hub liner.

Trailer and Tender Boxes

The method of packing tender truck boxes and trailer truck boxes without removable cellars should be the same as for freight and passenger cars.
The method of packing trailer boxes containing removable cellars should be the same as that used on engine trucks.
Some roads have eliminated the holes through the top of the trailer truck brass, and provided oil channels leading around the sides of the brass so that any oil poured on top will flow into the cellars and then be fed to the bearing from the packing.
The committee feels that substantial progress has been made in the development of improved lubrication methods in recent years and recommends that a continued study be made of this art.
The report is signed by G. W. Ditmore (chairman), master car builder, Delaware & Hudson; H. W. Johnson, superintendent motive power and rolling stock, Minneapolis & St. Louis; P. Maddox, superintendent car department, Chesapeake & Ohio; T. O. Sechrist, assistant superintendent machinery, Louisville & Nashville; G. E. Dailey, lubricating supervisor, Chicago, Burlington & Quincy; M. J. O'Connor, mechanical inspector, New York Central; C. B. Smith, engineer of tests, Boston & Maine; and E. Von Bergen, general air brake, lubrication and car heating engineer, Illinois Central.



Cylinders, Valve Chambers and Front End Open for Inspection

Discussion

Mr. Demarest: The question of service on the railroad and the question of enginehouse expenses is again involved in the subject of Mr. Ditmore's report. His suggestions in reference to blocking the holes in the top of the engine truck bearing are well worth serious consideration. Sometime ago one railroad in carrying out this investigation in relation to the cost of hot engine truck boxes attached a pipe to the top of the journal bearing through the top of the box and hung a can on the end of the pipe outside of the truck frame.

The result of that investigation showed that there was a flow of oil from the top of the journal bearing into the can. The resulting effect is further developed by the fact that you find out that your waste layer next to the journal in the engine truck box gets very dry; that by plugging the hole in the top of the engine truck bearing, the waste next to the journal maintains its oiling content a good deal better than where you have the top of the journal bearing blocked.

There is another way of preventing trouble in pumping oil in the hole on the top of the inner side of the journal. With the progress that has been made in the use of floating bushings, the economy that has resulted from rod maintenance and the freedom from hot bearings, it seems that we are quite slow in adopting a similar principle for engine and tender-truck journals, and also perhaps with the trailer truck journal. The question of freedom from rod tensions, and the continuous attention that have to be given to waste-packed boxes under engine and tender trucks is well worth further practical trials of floating bushings of journals.

Mr. Cromwell: A few years ago we used to cut the end plate liners of our driving boxes. We introduced the use of a gun to lubricate the end plates which helped matters considerably. Now we find that we get better results by using a heavier grease and applying it with a paddle on top of the box.

Mr. Ripley: This matter of engine truck lubrication is hitting at the sorest spot in locomotive failures today. That is particularly true in the long run territory, in dusty territory, such as in the western deserts and over the mountain territory where there are many curves. The amount of money you are spending in keeping engine trucks in running condition, so as to eliminate failures, is entirely too much. The present design of engine trucks is not satisfactory for use on heavy engines used on fast runs. These new developments which are mentioned by the committee are worth experiment by everybody. The point that is not touched on so much here is the question of hub heat which is troublesome in curve territory. If you feel a hot engine truck you will find almost invariably that the heat is retained in the hub face which is the hardest part to protect.

One method is now used in which grease is introduced from the outside of the wheel. This is a subject which has been considered by the wheel committee and taken up with the wheel manufacturers because many of the railroads have been afraid to drill a hole through the hub of the wheel for fear of weakening it. The manufacturers, in conference with us, have agreed that this is not dangerous to a wheel if the hole is drilled correctly. If you are going to drill the hole, drill it entirely through the hub and not at such an angle as to strike a portion of the plate or the radius where the plate joins the hub, thus making a continuous hole without any shoulders or offsets. In that way there is absolutely no danger involved.

We have become practically convinced that the hole in the top of the engine truck brass is an absolute detriment. It is losing oil instead of getting oil to the journal. It is not needed, even on the longest locomotive run. But my suggestion is that on the long runs, at intermediate terminals, you have some sort of a method by which you can introduce oil to the engine truck cellars without dropping it.

(*A motion to accept the report was carried*).

Report of Committee on Electric Rolling Stock

Rating of Locomotives, and Requirements of Insulation and Lubrication are Features of the Report

W. L. Bean
Chairman

The purpose of the work done by the committee has been to bring out desirable improvements in design and methods of operation and maintenance so that future projects will have the advantage of experience so far obtained on the electrified roads.

The following are the subjects which constitute this year's report:

Exhibit I—A Standard Method of Rating Electric Locomotives.
Exhibit II—Insulation as Reflected in Grounds, Blowouts and other Failures.
Exhibit III—Lubrication — Features of Design of Electric Locomotive Bearings and Maintenance Factors Affecting Lubrication in Electrified Service.
Exhibit IV—American Electrified Railroads.
 New York Central.
 Butte, Anaconda & Pacific.
 Norfolk and Western.
 Continuation Report of Virginian.
 Continuation Report of Illinois Central.
Exhibit V—Electrification Progress.
Exhibit VI—Tabulation of Electric Locomotive Equipment of Electrified Railroads of the World.

The subject of a standard method of rating an electric locomotive has proved to be a very interesting one as well as a very difficult and complicated one. It was found the various roads and manufacturers had different methods. For a means of comparison and for uniformity in practice it was felt the method outlined should prove useful. The report this year is one of progress rather than a recommendation. Next year it is intended to take the subject up for further development.

The paper on insulation points out the sources of trouble encountered most frequently and directs attention to means whereby the trouble can be precluded or practically eliminated.

The paper on features of design of electric locomotive bearings reviews the various systems in use and comments on their characteristics in service.

Under the heading "American Electrified Railroads" are descriptions of some of the roads not already covered in the A. R. A. proceedings. The committee decided it would be very desirable to have in manual form a source of reference covering all the electrified railroads and further, that this should be kept up to date. Therefore, it is intended to describe, each year, several roads. When all have been covered, the group will be assembled under one cover and thereafter kept up to date.

This year complete descriptions are given of the New York Central, the Butte, Anaconda & Pacific and the Norfolk & Western. Continuation reports are made for the Virginian and the Illinois Central. This year's report on the Virginian contains some interesting dynamometer car test records.

A tabulation showing locomotives put in service during the year ending June, 1928, has been included. This has been introduced by a short statement of the progress in electrification generally throughout the world as accurately as the committee was able to get it.

A group of tabulations have been worked up with the aid of

the electric manufacturers which show the principal facts of interest and dimensions of electric locomotives in use on all electrified railroads of the world. As far as is known this is at present the most comprehensive and detail summary available under one cover. It should prove very valuable for reference purposes in engineering and statistical work.

A Standard Method of Rating Electric Locomotives

The following is all of that part of the report which is listed as Exhibit I:

The determination of a standard method of rating electric locomotives is considered to be of major importance, but has proved to be a difficult one to answer satisfactorily. The report is, therefore, a progress report only, since the committee does not feel that the subject has been sufficiently considered to make definite recommendations for standardization at this time.

At present various ratings are used for electric locomotives, and these are arrived at in different ways so that there is no uniformity when comparing data on different locomotives. The ratings used are principally for the purpose of making general comparisons of the performance ability of different locomotives and are not sufficient for actually determining the ability of locomotives to handle certain work under specified conditions. For this purpose a great deal of exact engineering data is required. It is, therefore, thought, that for the purpose in mind, i. e., of providing a means of general comparison among different locomotives, an approximate method of giving ratings should be satisfactory.

The horse-power, speed and torque at the motor shafts under given conditions of motor voltage, ventilation, temperature rise, etc., may be determined accurately by stand test. There are, however, several factors, such as regulation of electrical apparatus, locomotive machinery friction, etc., which reduce these results before they reach the wheels. To cover these losses, an allowance representing the electrical losses and mechanical losses sustained with various types locomotives, must be made. It is suggested that this allowance may be represented by a factor *K* in the formula for tractive effort given below, and that a table of acceptable values of *K* be prepared to cover the losses for different types of locomotives.

There is considerable diversity among the methods of giving data on electric locomotives in various reports. By determining standard methods of rating for use in the table of locomotive data prepared by this committee, reasonably accurate comparison among different locomotives may be made and the results will be consistent and on a known basis.

The committee, therefore, feels that the method, suggested below, may prove acceptable; but does not feel that it would be warranted in making definite recommendations at this time, and feels that the subject should be continued for further study. The suggested method of rating is as follows:

(1) Electric locomotive ratings shall be considered as at the rims of the drivers, with locomotive on tangent, level track, and at constant speed.

(2) The locomotive ratings shall be: (a) Maximum start; (b) One hour; (c) Continuous.

(3) At each of these ratings, the following data shall be given: (a) Speed in miles per hour; (b) Tractive effort in pounds; (c) Horsepower, determined by the formula.

$$\text{H. P.} = \frac{\text{MPH} \times \text{TE}}{375}$$

(4) The locomotive ratings shall be based on motor shaft ratings for maximum start (except as noted in 7b), for one hour, and continuously, with motors operating at their rated voltage. The maximum start and one hour motor rating shall be determined with the motors starting cold. The maximum start motor rating shall be for one minute. A reduction in motor torque expressed as factor "K" in the formula for tractive effort, shall be made in determining tractive effort, to compensate for electrical and mechanical losses.

(5) The motor shaft ratings shall be determined by stand tests, and under conditions of temperature rise, ventilation, etc., as agreed on by the manufacturer and the purchaser, except as noted in (4) above.

(6) The tractive effort and the speed shall be determined by the formulae:

$$\text{TE} = \frac{\text{T} \times \text{G} \times 24}{\text{d} \times \text{P}} \times \text{K}$$

$$\text{M P H} = \frac{\text{S} \times \text{P} \times \text{d}}{336.1 \times \text{G}}$$

Where: T—Motor torque in foot pounds.
G—Number of gear teeth (if used).
P—Number of pinion teeth (if used).
d—Driver diameter in inches.
S—Revolutions per minute of motor.
K—A factor to compensate for electrical and mechanical losses.

(7a) The maximum start rating shall be the maximum tractive effort which can be exerted by the locomotive with any combination of motor connections, and at the maximum speed which can be attained with this combination.

(7b) If the tractive effort derived as in (7a) is greater than twenty-five per cent of the total weight on drivers, then the tractive effort shall be taken as twenty-five per cent of the total weight on drivers, and the speed shall be the maximum attainable at such tractive effort, with any combination of motor connections.

(8) The one-hour rating of the locomotive shall be determined from the one-hour rating of the motors.

(9) The continuous rating of the locomotives shall be determined from the continuous rating of the motors.

Insulation as Reflected in Grounds, Blowouts, and Other Failures

The following is all of that part of the report which is listed as Exhibit II:—

Insulation as reflected in grounds, blowouts and other failures might be divided into two classes; first: insulation as applied to wires, cables, etc.; second: insulation as applied to windings and other parts of the electrical apparatus.

Insulating material of the proper class to meet certain service conditions will, when properly applied, give long and satisfactory service, provided it is not subjected to excessive temperatures prevents proper radiation of heat and may cause abrasion or other mechanical damage. This feature can be taken care of satisfactorily in ordinary routine maintenance.

Insulation failures usually occur on account of rapid deterioration caused by excessive temperatures, the life up to the point of breakdown depending upon the length of time such temperatures are maintained. The high temperatures are usually the result of heat generated in the conductor surrounded by the insulation, and the heat generated,—which must be disipated,—is directly in proportion to the work done. As long as heat is generated faster than it is radiated off to the air, the temperature will continue to rise. As the temperature increases, however, the rate of radiation increases and eventually a balance is reached where the heat is radiated off as fast as it is generated. If the blanching temperature is not too high, or if the heating up process is stopped before excessive temperature is reached, no damage will result, but if the apparatus is overloaded and the heat is generated faster than it can be radiated, the insulation temperature will reach a point where rapid deterioration is set up. The extent to which overheating takes place, and the more often it occurs, the sooner failure will result. It might be said that the length of the life of insulation is that of a certain number of heat cycles within a certain temperature range, and as the temperature of each cycle is increased, the number of heat cycles that it will stand is likewise decreased.

The adequate insulation of wires and cables is not so difficult as the insulation of windings,—in that space limitations are not so restricted and the insulation can be protected from mechanical injury and heat. The majority of wires and cables used on electric rolling stock are usually insulated with 30 per cent. rubber and one or more weather or flameproof braids. Satisfactory results have been secured in some cases by wrapping cables with asbestos tape after installation. Failures, however, cccur but they can usually be traced to overloading or mechanical injury of the insulation.

The overload that might be safely carried depends on the temperature occasioned by the load previously carried, and on the length of time the overload is sustained; in other words, on the final temperature reached and on the time it is continued.

The current rating of a cable or wire from an insulation standpoint depends entirely upon allowable heating and is often limited by or is more dependent upon external conditions than upon heat generated in the conductor it surrounds. On account of the extreme variability of external conditions, the current rating may be reduced to a small fraction of the normal rating. Similarly the percentage of overload that a cable or wire can carry without injury to the insulation is dependent upon the external conditions as well as upon the heat produced within the cable itself. It is, therefore, of the utmost importance that wires and cables be so located that heat generated within the cable can be dissipated and that the insulation is not subjected to external heat radiated from other locomotives or car parts. The permissible overload is also dependent upon the temperature at the time of the application of the overload, the thermal capacity of the cable, and the duration of the overload. An insulated wire or cable will sometimes perform satisfactorily long after the insulation is badly injured by over-heating, but only as long as it is undisturbed and is not subjected to excessive vibration.

Satisfactory results can only be secured with insulation when the following are given due consideration in the design, construction and maintenance of equipment:

1. The conductor must be of sufficient size to carry the current without overheating the insulation, and the insulation should have sufficient factor of safety to withstand the voltage of the circuit in which it is used.
2. The type of insulation selected should be such as to withstand the condition to which it will be exposed. As far as practicable, the cables should be located so as to avoid abrasion, heat, oil drip, vibration or moisture.
3. Extreme care should be used to avoid kinking or bending on a short radius during installation.
4. If installed in conduits, they should be smooth and free from burrs inside.
5. Conduits should have approved bushings at terminals and protection should be provided to prevent the entrance of moisture.

The durability of insulation as applied to windings of electrical apparatus may be considered from two standpoints; viz., the mechanical and the electrical. Experience has shown that temperatures which may damage insulation from a mechanical standpoint may not seriously affect its dielectric strength. This is particularly true with moderate voltages where the insulation serves largely as a separating medium. Insulation has a two-fold function; first: it separates mechanically the conductors from each other and from other conducting material; second: it must withstand the voltage between the conductors and between the conductors and the non-current carrying parts. In the lower voltage classes of apparatus the first function usually applies, as the necessary mechanical separation is sufficient to withstand the voltage. In high voltage apparatus, however, the dielectric strength of the insulation is of first importance. The great majority of electric failures on low voltage apparatus are due to mechanical weakness of insulation, usually caused by high temperatures, which make it brittle, or crisp, so that it may flake off, powder, or crack off, allowing conductors to make contact with each other, or with adjacent conducting material.

The life of insulation varies within a wide range, depending on the service in which it is required to operate. Almost all insulating material will be affected in time, even though it is not subjected to definite deteriorating influences, such as excessive heat, vibration, moisture, etc. Because of these factors, the selection and arrangement of the insulation in a piece of machinery is of great importance to the designer.

Excessive temperatures probably contribute more to rapid deterioration,—which finally results in failure, than mechanical injury, vibration, or moisture. Insulation composed of fibrous materials such as paper, cotton, natural oil resins and gums, have a very long life if not subjected to temperatures in excess of 90 deg. C. They also have a comparatively long life when operated at temperatures not exceeding 105 deg. C., at temperatures higher than 105 deg. C., deterioration is very rapid, finally resulting in failures. Heat-resisting materials, such as mica, asbestos, and equivalent refractory materials, will stand higher temperatures, and rapid deterioration does not take place within the limits of about 150 deg. C.

In electrical apparatus the flow of heat from the conductors, comprising the winding, to the cooling air, is through the insulation. The value of the heat conductivity through insulation varies with its thickness and compactness as well as with different classes of materials. Air pockets very materially affect the heat conductivity, and loosely wrapped, unimpregnated insulation has about one-half the co-efficient of heat conduction of compact, tightly wrapped, impregnated insulation. Air pockets within insulation should be avoided in order to secure maximum conductivity of heat, and special attention should be given to the outside surface of insulation where it fits into the slots, so that complete contact between the insulation and the iron may be obtained.

The insulation available for motor and generator windings consists mainly of mica, treated and untreated fabrics, such as cotton and asbestos, and treated and untreated papers. On account of the severe service required of equipment in the electric traction field, and because of the space limitations imposed on its design, insulation of the windings of such machinery is practically confined to mica and asbestos fabrics and papers.

Mica is the only available insulation material where high dielectric strength is maintained at high temperatures, but owing to its physical characteristics, its use as an insulation is expensive. This is due to the fact that mica must undergo a great deal of detail preparation before it is ready for use, and when prepared, must be applied to the windings by hand. Individual conductors are insulated by wrapping with a narrow tape varying in thickness from .003 in. to .005 in., cut from sheets built up of .001 in. mica splittings pasted to one or two thicknesses of Japanese paper approximately .001 in. thick. The individual conductors after being insulated are grouped to form a poly-coil and are then hot moulded. The ground insulation is applied to the slot portion in the form of successive layers of tape similar to that used on the individual conductors. This insulation should be again hot moulded, after which an external protecting tape of cotton or asbestos is applied. It is very important that the coils be closely moulded to size, in order that they may be compact and closely fill the slot, so as not to become loose and permit chafing of insulation after the coils become dried out in service. An alternative method of applying the ground insulation is by wrapping the coil with a sheet of composite insulation .010 in. to .012 in. in thickness composed of pasted mica splittings and fish paper, or other tough paper approximately .004 in. in thickness. If the paper is any thicker than this, it is too stiff to permit the wrapping of the insulation around the coil close enough to make a solid job—and results in damage to the coil when the winder attempts to drive the coil into the slot.

Mica plate as slot insulation performs in service in much the same way as fish paper and mica. It is generally used where high dielectric strength is required and on the larger coils. One advantage of the mica plate slot insulation over fish paper and mica is the higher mica percentage and consequently a less amount of carbonaceous matter to shrink and cause looseness.

Asbestos in itself is comparatively poor as a dielectric, consequently its use as an insulating material for railway motor windings is largely confined to that of a spacing medium where low voltages are encountered and heat resistance is necessary. Also in a fabricated form such as tape or cloth, it is used where mechanical protection of a dielectric material such as mica is needed. When varnish treated, asbestos fabrics are very strong mechanically.

Some difference in construction methods and in the use of insulating materials has been employed in different types of locomotives and cars. The principal insulating materials and their uses are shown in the table.

Principal Insulating Material and Their Uses

Material	Used for
Asbestos	Asbestos lumber and formed asbestos used for contractor arc chutes, spacing blocks, etc. Asbestos cloth for armature heat dressing. Asbestos cloth for coil covering.
Mica—(All forms)	Formed mica for insulating rod supports, commutators, "V" rings, end bells, end coil covering, etc. Built up mica and paper used for insulating field coils and armature coils of practically all rotating equipment.
Micarta	Formed insulation for switch and relay assembly, small panels, fuse holders, spacing blocks, barriers, etc.
Porcelain	Special pin type insulators for pantograph supports. Pin type for cable supports (on roof). Spool type for bus bar and panel supports, grid resistance supports, switch group and contactor supports, brush-holder supports and miscellaneous uses.
Rubber	Insulation on motor leads, power cables, control wiring, etc.
Paints, Varnishes, Shellac, Impregnating Compound, Etc.	Used for treating field coils, armature coils, armatures, panels, etc., as required to obtain moisture and dust-proof surface.
Wood	Wood rods, impregnated and varnished, used in some cases as insulated operating rods. On some low voltage equipment, wood cleats and separators used for insulation.
Miscellaneous	Fish paper, vulcanized fibre, Fuller board, press board, bakelite, oiled cambric, etc., used for various purposes.

Many insulating materials other than those named above are used, but in such small quantities that they will not be considered here.

The following remarks apply to failures on locomotives and cars, taken collectively, and are listed in the order of their importance as affecting electric operation as regards inconvenience to operation and expense of making repairs:

(1) Grounded or Short Circuited Armature Coils, Field Coils, or Leads on Rotating Equipment.

(a) Moisture in motor cases and transformers due to openings in housings, type of ventilating system used, etc. Corrected by improvements in ventilating system, closing openings during severe snow storms, and improvements in maintenance of insulation of armature and field coils.

(b) Chafing of armature coils at the rear end due to insufficient space for expansion. Corrected by setting end bell out to provide space.

(c) Short circuited coils back of commutator risers, caused by foreign metallic substance, moisture, or poor workmanship.

(d) Mechanical injury to insulation resulting from rough handling, foreign objects, or vibration. Field coil failures due to broken cable insulation caused by heat and aging, chafing, the effects of oil, etc.

(2) Grounded Brush Holder and Brush Holder Studs on Traction Motors and Other Rotating Equipment

(a) Grounded studs caused by failure of mica insulating sleeve on brush holder stud, usually under conditions of increased voltage. Failure usually occurs where stud enters clamping block and may be aggravated by presence of oil or moisture. Failures reduced by special inspection and high tension dielectric test of insulation on studs at regular intervals.

(b) Grounded brush holders caused by flash-over at commutator and from commutator or ground. Also caused by leakage over dirty insulators, as some insulators are so located as to be hard to clean and inspect. Condition improved by application of arcing horns to traction motors, and careful inspection of commutators, brushes, brush holder insulators, etc.

(3) Failure of Insulation on 3,000-Volt Cables

(a) Caused by aging, overheating, moisture, or mechanical damage to insulation on cables. Failure often occurs where cable enters conduit and where bending of cable causes insulation to crack. Failures reduced by inspection and testing.

(b) Caused by chafing of cable, or improper application of insulation where splice or joint has been made.

(4) Miscellaneous Failures on 3,000-Volt Insulation

(a) Failures due to leakage over surface of built-up insulation, due to cracked porcelain insulation or other minor causes.

(5) Failures of Low Voltage Insulation

(a) Failures due to chafing or abrasion of wires and cables, presence of moisture or oil, or other similar causes. Relatively few cases of failure on low voltage circuits.

(6) Failure of Porcelain Insulators

(a) Failures usually caused by cracked insulation, dirty surface, or presence of moisture and dust combined. Very few failures of this sort.

From the information given above, it is clear that moisture is perhaps one of the worst enemies of insulation on electric locomotive and car equipments. In an effort to make the insulation of rotating equipment heat resisting, material has been selected which is easily affected by moisture. Rubber insulation, used for cables, is quite impervious to moisture, but is easily damaged by temperatures considered moderate for windings of armatures, fields, etc. Some improvement, therefore, would seem to be possible in both kinds of insulation.

As all insulation dries out and hardens in time, it has been found that periodic dipping and baking with specially prepared varnishes or compounds will keep the insulation soft and pliable. Where the service requirements are not so severe, it has been found that dipping and baking every two years will keep the insulation in good condition; if, however, the service requirements are severe, the intervals between such treatment should depend largely upon the temperature at which the equipment is operated.

Porcelain insulation should be used wherever possible in place of fibre, micarta, bakelite, etc., as these last named products are all combustible to a certain degree, and should be avoided wherever possible. They also lose their polished surface in time and must be re-finished so as to avoid possibility of surface creepage and carbonization.

Improvement in the design of electrical equipment, character of insulation used, ventilating systems employed, and maintenance methods, are subjects which must receive serious consideration if insulation failures on electric locomotive and car equipment are to be reduced to the minimum.

Lubrication Features of Design of Electric Locomotive Bearings and Maintenance Factors Affecting Lubrication in Electrified Service

The following is all of that part of the report which is listed as Exhibit III.

The present paper is not a treatise of the theory of lubrication, which is a voluminous subject, but is confined to a description of the methods of lubrication used on electric locomotives. Some bearing, such as wheel journals and rods, are common to both steam and electric locomotive practice, though the service requirements are different in some respects. Other bearings, such as motor armature shaft bearings, motor axle bearings, jackshaft bearings, quill bearings, the bearings on phase converters and motor-generator sets, gears and pinions, and auxiliary equipment such as compressors and blower motors, are peculiar to electric locomotives.

The design of an electric locomotive should be so balanced that the period of classified repairs will not be based on any one detail; also electric locomotives are usually given a periodic inspection about once a month. Bearings and their lubrication should, therefore, be such that no heavy work will have to be done on these parts within the classified repair period as determined by other parts, and they should also preferably require no attention whatever between periodic inspections, and the minimum at that time. Such parts, including bearings, as may require renewal or other work between regular repair periods, should be given special attention in design to permit performing the work with the least disturbance of other equipment.

The problems of rod design and lubrication for electric locomotives seem to be about the same as for steam locomotives. The conditions surrounding wheel journal operation are, however, rather different and may require modification of design. On many types of electric locomotives, outside journals, which are readily accessible, are used, and this permits of design accordingly. Many electric locomotives do not have side rods. Grease lubrication on journals where rods are not used, has been found to be very difficult, since the movement of the axle in the brass, due to the action of the rods, seems necessary to properly distribute grease. Oil lubrication of wheel journals under this condition, therefore, seems preferable. On side rod locomotives where grease is used, a problem is introduced by the operation of the locomotive in both directions. Special grooving in the brasses must be provided, and there seems also to be in some cases, a displacement of grease and screens due to operation in one direction, which causes improper lubrication when movement is made in the other direction.

The methods of lubrication commonly employed on apparatus peculiar to electric locomotives are: Oil and waste; drip feed; ring oilers; circulating oil feed with a pump; oil or grease for ball or roller bearings; oil or grease for gears and pinions. For air compressors, the splash system is usually employed. The choice is based on the experience and judgment of the designer, or in some cases, on the space available or other physical limitations.

Oil and waste is the most commonly used method of lubrication. The application differs somewhat from that on wheel journals. The bearing surrounds the shaft, being either a solid bushing or split, according to the design and location. The waste bears against the shaft through a "window" in the bearing located on the side of least load. The waste is held in a cavity of the housing surrounding the bearing, the lower part of the cavity acting as a reservoir to hold a quantity of oil. The oil is lifted by wick action of the waste through the window to the part of the shaft which the waste touches. Since the "window" does not extend the whole length of the bearing, oil grooves are supplied to carry oil from the "window" to the parts of the bearing not directly lubricated by the waste. The quality of oil, kind of waste used and method of packing, amount of lift of the oil by the waste, and level of reserve oil, are supposed to be so balanced that if the bearing is filled to a given depth of oil, the rate of feed will not be excessive and wasteful when the bearing is first filled, but will still be sufficient to last until more oil is added at a later date. Actually, it is sometimes difficult to attain this end, since there are uncontrollable factors such as fit of bearings and temperature which play important parts. An auxiliary device, acting on the principle of the chicken drinking fountain, is sometimes employed to supply oil from a separate reservoir and maintain a constant level in the waste cavity. In this device, oil is carried in an air tight cavity cored out in the housing of the bearing, the lower end of the cavity opening below the level of oil normally carried in the bottom of the waste pocket. When the oil level in the waste pocket falls below normal, the end of the connection to the reserve oil reservoir is uncovered, air flows up into the reservoir and oil flows down to the waste pocket until the normal level is restored, and the opening again covered. Arrangement of siphons and a special pump are necessary to remove the air and introduce the oil, when the reservoir is refilled.

As compared to the oil and waste lubrication employed on wheel journals, the arrangement used on motor bearings is an improvement in that a reserve supply of oil is provided to give continued service without frequent attention. Unless the auxiliary device mentioned above is used, it has the inherent weakness that the rate of feed is dependent on the height of oil, as well as other factors. Also dependence must be placed on oil grooves to supply the ends of the bearing, while on a wheel journal, the waste touches the whole length of the bearing.

The proportions of the oil reservoir into which the waste dips are important. It should be of as large area as possible to provide a supply of oil over a long period without much change of oil level. In one case improvement was made by raising the waste window in the bearing to give greater depth to the reservoir, but depth can only be effective to the height through which waste can lift oil.

Drip Feed

Drip feed from some form of sight feed lubricator, may be employed. This system has several disadvantages. Dependence must be placed on men turning it on and off, and regulating the feed properly, unless a fixed feed is used. Usually it is located in the locomotive where the temperature may be very low in winter and difficulty will be experienced in making it feed regularly or perhaps at all. Air pressure and heaters are sometimes used. If a multiple lubricator is used, pipes must run to the various bearings, and in cold weather the oil congeals in the pipes. Under certain conditions, the drip feed system may be made to work satisfactorily, but often this is not the case.

Ring Oilers

Ring oilers are used widely on industrial motors and to some extent on the motors, phase-converters, etc., of electric locomotives. They consist of a narrow metal ring around the shaft and bearing, hanging on the top of the shaft through a slot in the top of the bearing, and dipping into oil in a reservoir under the bearing. As the shaft revolves, it rotates the ring, and oil is carried up on the ring from the reservoir to the top of the shaft, where it is distributed by oil grooves in the bearing. Usually two or more rings are used for reliability. The oil which works out of the ends of the bearing is returned to the reservoir, making it an automatic circulating system. The arrangement is admirably simple and effective under suitable operating conditions. It has drawbacks, however. Small pieces

of foreign matter may wedge under a ring and prevent its rotating. The location and cover over the ring inspection opening should, therefore, be such that dirt cannot enter, and care must be exercised in filling the bearings with oil. On a locomotive, the bearings may become chilled during cold weather and the oil in which the ring dips may become so thick as to prevent the ring from turning, and the bearing may be damaged before the heat from the bearing warms up the oil in the reservoir underneath. This might be at least mitigated by using special oil with low cold test. Rings are sometimes made in two pieces for ease of installation. This practice is dangerous as the fastenings often fail, permitting the parts to separate, with failure of lubrication. Rings must be round and smooth. Slots in bearings must be smooth and large enough to clear rings under all conditions. Under certain conditions of vibration rings may fail to function. At least two rings, either one capable of supplying sufficient oil to the bearing and with suitable distributing grooves, should always be provided. Also, since this system floods the bearing with oil, proper care must be taken to prevent oil working out of the bearings and into parts of electrical apparatus where it may be injurious. In some places, space is not available for the installation of this type of lubricator.

Circulating Systems

Circulating systems employing oil pumps, generally driven by the movement of the locomotive, are used to some extent. The idea is fundamentally that used on most automobile engines. Oil is pumped from a reservoir or sump to the various bearings and after passing through the bearings, is returned to the sump. The system is entirely automatic and supplies oil in proportion to the speed of the locomotive. It has the disadvantage that on a slow, heavy start, oil may not reach the bearing until after the locomotive has progressed for some distance, dependence being placed on the oil film in the bearing. At high speeds a surplus of oil is supplied and means must be provided to insure that the oil will be returned to the sump and not leak out. Since the sump must be located below the lowest bearing, and the pump should be at the bottom of the sump, difficulty is experienced with some types of locomotive in locating the sump and pump. The gear type of pump in general use on automobiles is not readily reversible, and the plunger type is therefore used. Since the pump is small, the valves are small and care must be exercised to prevent particles of foreign matter getting under the valves. Settling chambers and fine meshed strainers should be provided, and care exercised in handling the oil. Oil delivery pipes should have no parts which may drain, since in cold weather the pump would have to fill the empty pipe with oil which is too thick to run freely, before any oil reaches the bearing. The use of a single pump with distribution of oil through a manifold to several bearings is not satisfactory, since at low speeds the oil will all tend to go through the pipe having the least resistance. This is particularly the case during cold weather where the thick oil must be actually forced through the pipe. Hence, a separate plunger to supply oil to each bearing is preferable. As in the case of the ring bearing, care must be taken that oil from the ends of the bearing does not reach places where it will do damage. Since the pump may become chilled and the oil thick during cold weather, an oil with very low cold test must be used in winter, otherwise the oil will not pass the strainer nor flow through the suction valves of the pump. It might even be necessary to provide a heater to warm up the pump prior to starting out with a locomotive which has become thoroughly chilled. This system, properly designed, may be made very satisfactory.

Ball and Roller Bearings

For ball and roller bearings, either grease or oil may be used, preferably the latter if the bearing housing is designed to retain it. The housing should be so constructed as to hold the lubricant, and to exclude dirt. Felt washers are fairly satisfactory for grease, but will not hold oil. Various arrangements of labyrinth packing promise satisfactory results. A suitable grease must be such that it will not pack during cold weather, and not separate nor work out of the bearing in hot weather. It must always be thin enough to work down so that the bearing may pick it up. Grease also retains particles of steel and dirt, which are abrasive in their action on bearings.

Altogether, oil is generally to be preferred, though it is more difficult to retain in a bearing, and in fact cannot be used unless the bearing is designed for it. Any lubricant must, of course, be practically neutral, that is non-acid and non-alkaline, to avoid corrosion of balls and races. On a high-speed bearing, too much oil, too thick an oil, may cause heating. With a grease lubricated bearing, it is difficult to tell when more grease is needed without opening up the bearing, which is undesirable on account of the probability of dirt entering. An oil-lubricated bearing may be provided with some form of indicator to show the oil level, or may have an overflow which will drain off any surplus if too much oil is added. Ball or roller bearings are used extensively and satisfactorily on small auxiliary equipment and there seems no reason why they may not be adapted to the larged pieces of apparatus. Their satisfactory operation should virtually eliminate bearing troubles and maintenance charges.

It has been the experience of one road, however, that a sleeve bearing worked out better than a ball bearing, but if the ball bearings are of the proper size and the design is suitable, this does not seem to be the usual case.

Gears and Pinions

For gears and pinions, grease is generally used, on account of the comparative ease with which it can be retained in a gear case. A sticky grease which will adhere to the surfaces of the gear teeth is desirable, and it should be very viscous, since the unit pressures of gear teeth are very high. It must, however, be thin enough to settle to the bottom of the gear case where it may be picked up by the teeth, in cold weather. A heavy oil has many desirable characteristics, but as noted, is not generally used on account of the difficulty in retaining it in the gear case. Some types of flexible gears and pinions, however, require oil, since grease would not penetrate into some of the parts requiring lubrication. Possibly a slow, continuous feed of oil may be a satisfactory solution.

Air Compressors

Air compressors are generally lubricated by the splash system, where the crank case is filled with oil and the ends of the connecting rods dip into the oil each revolution and splash the oil over the cylinder walls and into the cavities leading into the bearings. The gears also receive oil from the same source and the system is entirely automatic. Generally a filling plug is provided and oil is replenished to a determined level. A few types of large compressors have a system of forced lubrication, employing a pump. Suitable oil of high flash point must be used in air compressors, or oil explosions may result.

On electric locomotives, as on other rolling stock, experience has indicated that where climatic conditions are severe, different qualities of lubricant, both oil and grease, may be necessary for summer and winter use.

Effect of Oil on Insulation

The insulating materials used in electrical apparatus are susceptible to damage from oil and serious and expensive damage may result if oil is permitted to get inside of motors or other apparatus.

Bearings, and particularly those using a circulating system where oil is supplied freely, must be designed to prevent leakage of oil from the bearings into the apparatus. The joints of split bearings must be tight or other means provided to eliminate leakage. Slings and drainage grooves must be provided to stop oil from working along the shaft; and an insidious form of trouble is oil carried in from the bearing by a current of air. Motor armatures and other rotating parts are apt to have a fan action which creates a low vacuum at the shaft, and may draw a current of air through the drain passages of the bearing. Oil thrown from the slings in a finely divided spray, or possibly portions of the oil which distill off when the motor is hot, may be drawn in by the air current, and settle out inside the motor. This condition should be kept in mind.

(The remainder of the report consists essentially of a compilation of descriptive information concerning existing electric traction systems and is too voluminous for inclusion in this abstract.—Editor.)

The report is signed by W. L. Bean (chairman), mechanical manager, New York, New Haven & Hartford Railroad; J. A. Carmody, superintendent electrical equipment, New York Central Railroad; J. H. Davis, chief engineer, electric traction, Baltimore & Ohio Railroad; A. Kearney, superintendent motive power, Norfolk & Western Railway; J. V. B. Duer, electrical engineer, Pennsylvania System; J. W. Sasser, superintendent motive power, Virginian Railway; E. W. Jansen, electrical engineer, Illinois Central Railroad; R. Beeuwkes, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific Railroad.

Discussion

F. H. Shepard, (Westinghouse): We have advanced this last hundred years and the rail transportation of this country is the reason for the success of the industry of this country and for its growth. Where are you headed? You have got your hard surface highways, and automobiles and the expense for automobile transportation in this country is large.

There will always remain for the railways of this country a vastly increasing amount of business on their main highways.

My prognosis is that the easiest way to increase the capacity will be with the most flexible power we know anything about and that is electricity. Transportation and the necessity for transportation grows faster than the population. As far as dependability is concerned, there isn't any question about the dependability of electric operation.

As far as the possibilities of the future are concerned we all know that we can put all the power on a train, to handle all the tonnage and at all the speed that the rest of the railroad and your equipment will stand. Down on the Virginian they work up to 20,000 hp. on a single train and I am not sure that a good many of us in this room might not see 40,000 hp. on a train before we get through. If 40,000 hp. is coming it is going to be electricity.

We are headed and headed faster than we know toward higher speeds in both freight and passenger service and higher tonnage in each and with the consequent increase in power per train and by that most flexible power, electric operation.

A. H. Armstrong, (General Electric Company): The subject of electrification is not new to any of you and my remarks are not going to be along the lines of what might be called propaganda for the one product we do make in your line and that is electric locomotives. But I am delighted with this Association that it has, through its various committees, taken such an active interest in tabulating the results of the various electrifications in the country and in continuing the work of putting before you the publicity of construction and operating results of electric locomotives. In our desire and enthusiasm to put over a new accomplishment we may have, at times, made very enthusiastic statements. And the deliberate and careful work done by your committee in analyzing results, and there are enough locomotives run in this country and abroad to make such analysis worthwhile, I think will lead to a feeling of confidence and a broad view of the matter of a full understanding on both sides that will lead to good results.

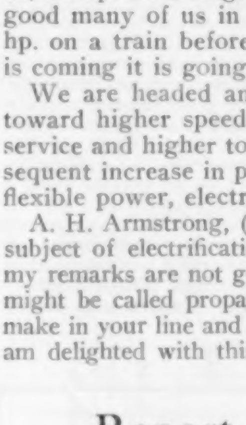
The electric locomotive has possibilities that is denied the steam engine. It can, as Mr. Shepard pointed out, haul any train at any speed that will hold together; that is, it is possible to build such a machine. Whether it is economically expedient to install a locomotive of that kind and operate it, will be determined by the findings of your several committees.

The rating of electric locomotives, as compared to steam, is occupying the attention of this committee and I think it is only fitting that the men who have determined steam engine performances should also go at, in the same way, the determination of the electric locomotive, and I look forward to the results of the continued work of this committee with a great deal of satisfaction, as I think it will contribute largely to the development of the electrification of steam roads.

(A motion to accept the report was carried.)

Report of Committee on Utilization of Locomotives

Locomotive performance records analyzed——Important fuel economy factors outlined——Trends indicated



T. B. Hamilton
Chairman

The activities of your committee during the past year consisted of analyses of performances without making any field surveys.

To illustrate the trends and determine factors of improvements in performance, the volumes and unit performances have been charted by years from 1920 to 1927 inclusive, and are presented in this report. The studies have been divided between freight, passenger and yard performance as to Class I carriers as a whole, and in some cases the twenty-six selected carriers shown in the quarterly and annual reports.

Freight Service Volumes

The totals of selected volumes are shown in the table.

Freight Train Performance of the Class I Railways

	Gross ton-miles; exc. loco. and tender (millions)	Train miles (1,000)	Train hours (1,000)	Locomotive miles (1,000)	Tons of fuel used (1,000)
1920	913,851	633,527	61,429	718,605	89,925
1921	759,245	528,942	45,829	593,552	69,939
1922	813,741	555,789	50,269	624,963	75,694
1923	987,384	641,558	58,885	725,663	90,033
1924	933,968	600.575	52,240	673,521	81,025
1925	1,023,370	612,680	51,988	689,572	81,316
1926	1,098,985	632,927	53,065	714,423	85.095
1927	1,086,829	610,497	49,526	689,177	80,416

Chart A, reflecting these trends by percentages of increase or decrease compared with 1920, shows that the increases in gross ton miles were accomplished with decreases in train hours, train miles, locomotive miles and tons of fuel consumed.

The four factors showing reductions in volume have resulted in direct savings in operating expenses. The volume of train miles has been reduced by increasing the train load, and this has likewise reduced the volume of locomotive miles. The volume of train hours has been reduced by increasing the terminal-to-terminal train speed and train load. The volume of fuel consumption has been decreased because of increased train load, improved locomotive design, and increased fuel conservation activities.

Chart B (not shown) gives the same items in percentage of increase or decrease for 1927 compared with 1920, by regions. The Pocahontas region reflected the greater increase in gross ton miles; the New England, Central Eastern and Northwestern regions reflected lesser increases in gross ton miles.

Chart C shows in percentages of increase or decrease for each year compared with 1920, Class I carriers, the train speed, gross tons per train, gross ton miles per train hour, the work done per locomotive service hour per average tractive effort pound-mile, miles per day per active locomotive, and equivalent hours of service over or under eight hours per day.

This committee was created in the latter part of 1924 to give study to the subject of increased utilization of locomotives. Since that time quarterly reports have been issued to the members. The performance per active locomotive is comparable from 1921 to 1927 inclusive, but not with 1920, as the 1920 data for stored and unserviceable locomotives was reported on a different basis; for this reason the reported miles per day per active locomotive were greater in 1920 than in any subsequent period.

Since 1924 the percentages of increase in tons per train has been greater than that of train speed. Train speed has been referred to in previous reports as possible of increase without materially increasing the running speed, by reducing train movement delays. It is recommended this factor be given further attention, particularly because the train crew pay basis of eight hours or 100 miles per day, implies a minimum speed of 12.5 miles per hour. In this respect train speed of 12.3 miles per hour is still 1.6 per cent below the minimum referred to. An increase in train speed will reduce the crew road hours, and at the same time afford a better utilization of the equipment employed.

The increase in trailing load per train from 1,442 in 1920 to 1,780 in 1927, was 23 per cent, as compared with 17.3 per cent increase in average tractive effort pound rating of locomotive. This indicates more work done per unit of hauling power in 1927.

Gross ton miles per train hour were 47.5 per cent greater in 1927 than in 1920. In general, this factor is the product of speed and train tonnage. It has been determined that the train speed was 1.6 per cent less than the 12.5 rate referred to, but as yet it has not been determined what the economical tonnage per train

should be, to prescribe an objective in gross ton miles per train hour, due to varying conditions. Another factor referred to in the quarterly reports is gross ton miles per locomotive day, instead of per hour, involving the additional element of miles per active locomotive day, and in this respect the performance was 19.2 per cent greater in 1927 than in 1920. To increase the work done per day, therefore, it involves operating locomotives more than single crew runs, since freight terminal frequencies and crew district mileages are not always subject to revision.

As to the work done by locomotives in active service, the miles per day per active locomotive as a measure are not entirely comprehensive. The active unit has also done more work per

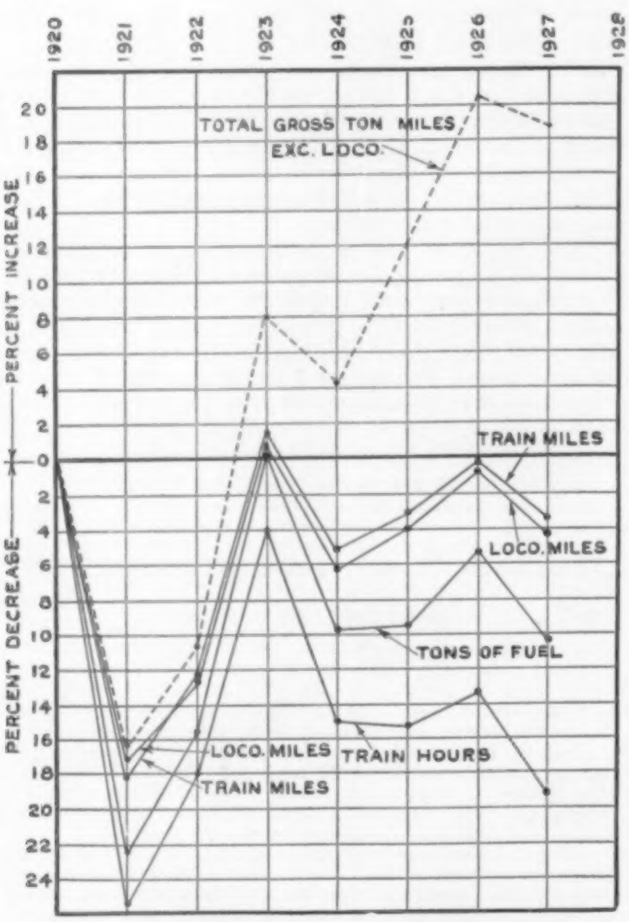


Chart A—Freight Service Volume Trends Expressed in Percentages

mile, per hour and per day. By taking the average tractive effort pounds per locomotive, times the miles per hour per active unit, and this sum (reduced to thousands), divided into the gross ton miles per train hour, we have the factors shown in column (f) of Table No. 2. The percentages of change since 1924 are shown on Chart C, and indicate more work done per locomotive road hour.

While more work was done per active locomotive mile, hour and day, it would seem there is room for further improvement in miles per active locomotive day. Considering the crew-pay basis of eight hours or 100 miles per day or crew-run, and the consequent minimum speed of 12.5 miles per hour, it appears that to prevent crew over-time it is desirable to run 100 miles or more in less than eight hours per crew and at greater average speed than 12.5 miles per hour. Chart D is an illustration of the trends of locomotive miles per day, train speed and hours of service. It indicates that at no time did Class I carriers as a whole reach 100 miles per day.

Chart C also shows the percentage over or under eight hours of service per active locomotive day, obtained by dividing the locomotive miles per day by the train speed in miles per hour. This is essentially an equivalent, since there is a difference between train and locomotive mileage. For each train mile, locomotives run an average of 1.128 miles, due to double-heading, helper and light locomotive mileage. However, train switching is excluded from the miles per locomotive day, so that there is an approximate offset.

To arrive at a distribution of the 24 hour day per active freight locomotive, the factors used were (a) the hours of service per day, explained above and (b) hours of service per train per day, arrived at by dividing the gross ton miles per active locomotive day by the gross ton miles per train hour. For each year, this gave the distribution shown in the table.

Distribution of Freight Locomotive Hours

		Distribution of time in column (a)		
	Locomotive hours out of engine house (a)	Locomotive hours on train (b)	Locomotive hours out of engine house but not on train (c)	Locomotive hours in engine terminal (d)
1920	8.63	7.65	.98	15.37
1921	6.79	6.03	.76	17.21
1922	7.25	6.37	.88	16.75
1923	7.34	6.61	.73	16.76
1924	6.90	6.15	.75	17.10
1925	6.97	6.21	.76	17.03
1926	7.15	6.32	.83	16.85
1927	6.95	6.14	.81	17.05

The 1920 data is not comparable with that of the subsequent periods as previously explained. Approximately 17 hours per day in the enginehouse premises, as shown above, is more than is needed for proper maintenance, particularly if our previous recommendations are followed to do all possible running repair work at monthly certificate time and thus reduce intermediate running repairs to a minimum. Such a plan makes locomotives available for longer continuous periods of road service. Action should be taken to extend the road service time with the objective of reducing the daily enginehouse hours from 17 to 10, because proper maintenance can be accomplished on an average from six to eight hours per day as developed from field surveys.

Recommendations have been made from time to time to increase the number of crew-runs per locomotive run. To determine what progress was made in this respect, questionnaire was issued March 1, 1928, asking for the number of continuous freight locomotive runs of 2, 3, 4, 5 and more crew-runs. Replies were received

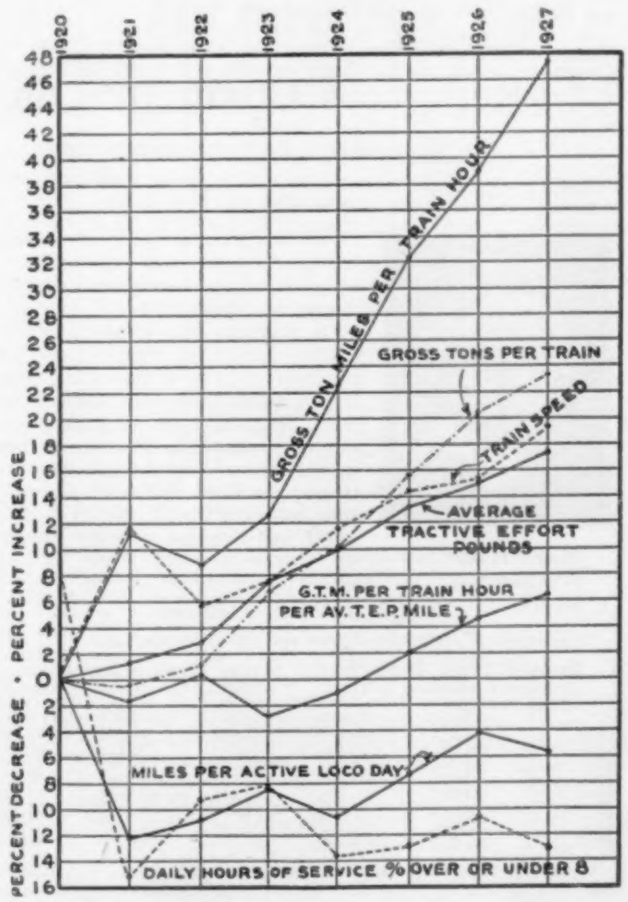


Chart C—Percentage Unit Locomotive and Train Performances

from 126 railroads. It was realized no specific records were kept of such information and that the data would therefore be approximate. For that reason the record of only one day of each year was used. Summary of replies is as follows:

	6-30-25	6-30-26	6-30-27	1-1-28
No. of two-crew runs........	393	511	660	749
No. of three-crew runs.......	25	43	60	71
No. of four-crew runs........	9	13	14	19
No. of five-crew runs.........	0	0	1	3
No. of more than five crews..	1	1	2	4
Totals.................	428	568	737	846

This indicates considerable progress in increasing the number of extended locomotive runs.

Amount of Power Used and Condition

The following table shows the number of freight locomotives reported as owned by Class I carriers, the number unserviceable, serviceable, stored and active.

Freight Locomotives of the Class I Railways

	Total	Unserviceable	Serviceable	Stored	Active
1920........	30080	7318	22762	669	23093
1921........	32891	7885	25006	4190	20816
1922........	32940	8404	24536	2932	21604
1923........	32976	7118	25858	1481	24377
1924........	33240	6237	26003	3827	22176
1925........	32450	5791	26659	3719	22940
1926........	31652	5194	26458	3448	23010
1927........	30991	4988	26003	3926	22077

The percentage of increase in total number of units was less in 1927 than any other year since 1920, and it is expected that as the average tractive effort of locomotives increases and the work per day increases, there will be a corresponding decrease in the relative number owned. The percentage serviceable has increased and the percentage unserviceable has decreased materially.

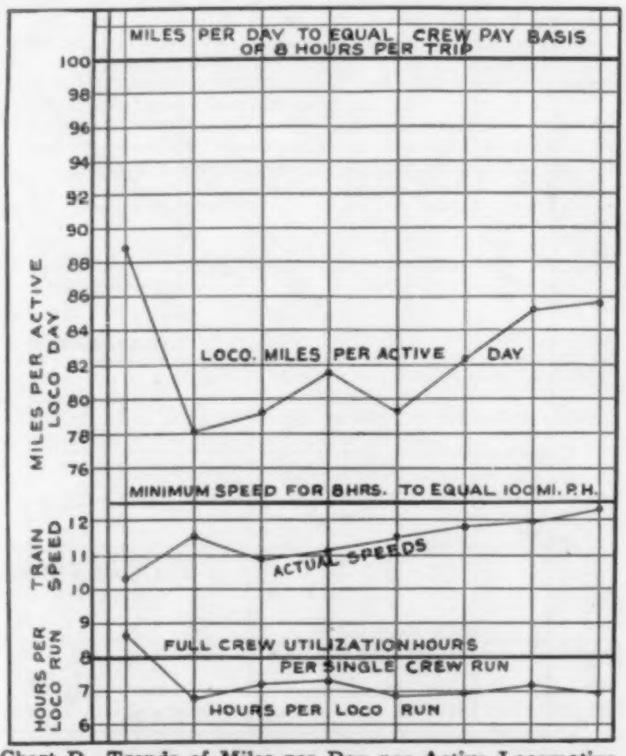


Chart D—Trends of Miles per Day per Active Locomotive, Train Speed and Equivalent Hours of Service per Train

The OS-A forms of the interstate commerce commission provide for reporting the number of locomotives as follows:

Item	Data
12.......	Average number of locomotives, serviceable (including stored)
13.......	Average number of locomotives, unserviceable (including those held for dismantling or sale)
14.......	Average number of locomotives on line
15.......	Average number of locomotives stored

It has been the practice of your committee to deduct the number stored from the number serviceable to arrive at the number active in the quarterly and annual statistics issued to member roads.

The OS-A instructions define the counting of units by taking the total locomotive days of 24 hours assignable to freight service, and dividing same by the number of days in the period.

A stored locomotive is defined as one under *white-lead or stored* in serviceable condition and available for service. The counting being on the 24-hour day basis, we feel that this means any unit available for service, but not used in any one 24-hour period, constitutes a stored locomotive day in the period. Your committee recommends that this interpretation be followed, as otherwise the statistics used for arriving at the actual number active will be misleading. These instructions are not being followed uniformly, and, in order to have this information comparable, the reporting should be uniform. Therefore, your committee offers the following recommendations in compliance with existing instructions:

"In analyzing the operating statistics report to the interstate commerce commission by Class I carriers and in the field surveys of the sub-committee on Utilization of Locomotives, we find a wide variation in the interpretation and application of the I. C. C. instructions Item (I) of the OS-A form and Item (E) of the OS-B form, which items read as follows:

> " 'Item (I)—The term "Stored Locomotives" means locomotives under white lead or stored in serviceable condition and available for service. The term "Unserviceable Locomotives" includes unserviceable locomotives stored or awaiting sale and also locomotives awaiting or undergoing repairs, if held more than 24 hours on that account.'

"Item (E) is the same as Item (I) except that it pertains to passenger locomotives.

"We feel it is important that a uniform practice be followed in applying these instructions for the reason that the only statistics available for determining the miles per day per active locomotive are obtained by deducting the sum of the unserviceable and stored locomotives from the total on line and dividing this result into the locomotive mileage. The first possibility of discrepancy is in the method of counting locomotives stored. Some carriers require a lapse of a certain number of days before placing the locomotive in the stored list while others place locomotives in the stored list if serviceable for 24 hours, but not used.

"Further discrepancies are developed by the fact that the instructions provide that any locomotive held over 24 hours for repairs is to be counted as unserviceable. Some carriers interpret this as clock hours while others interpret it as clock hours required to make the repairs.

"In order to obtain uniformity of application of the instructions and arrive at comparable results we recommend that the matter be taken up

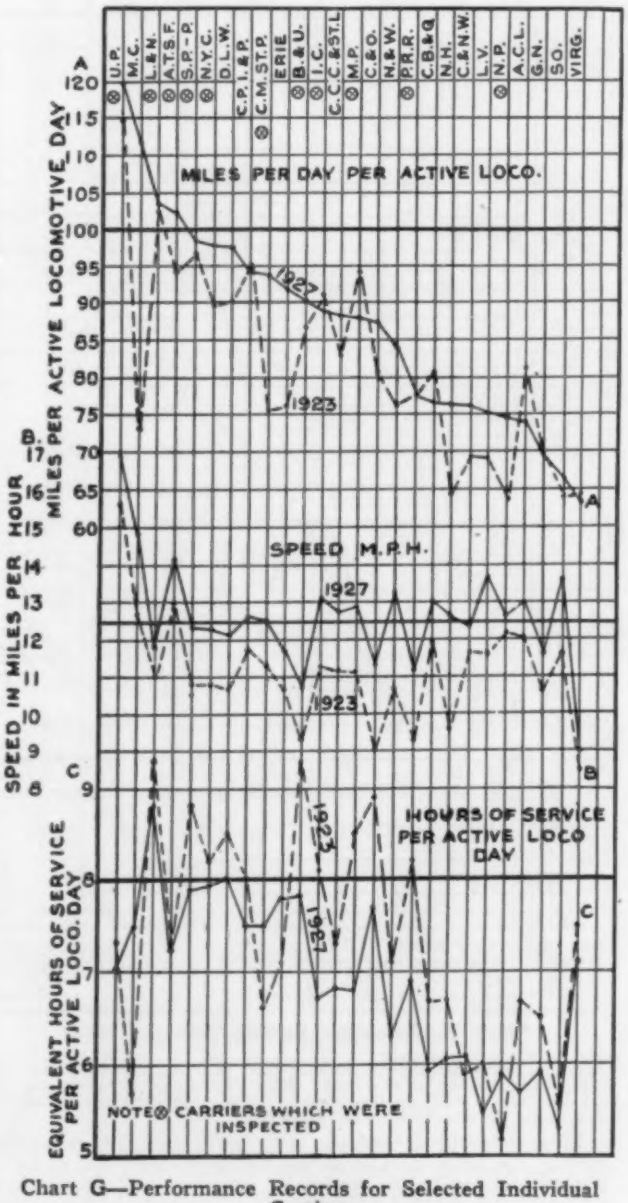


Chart G—Performance Records for Selected Individual Carriers

with the interstate commerce commission and the instructions clarified as follows:

"*Stored Locomotives.*—The term 'Stored Locomotives' means locomotives under white lead or locomotives in serviceable condition and available for service which have made no mileage in a calendar day. It is understood that a calendar day means the time 12 midnight to 12 midnight.

"*Unserviceable Locomotives*—The term 'unserviceable locomotives' in-

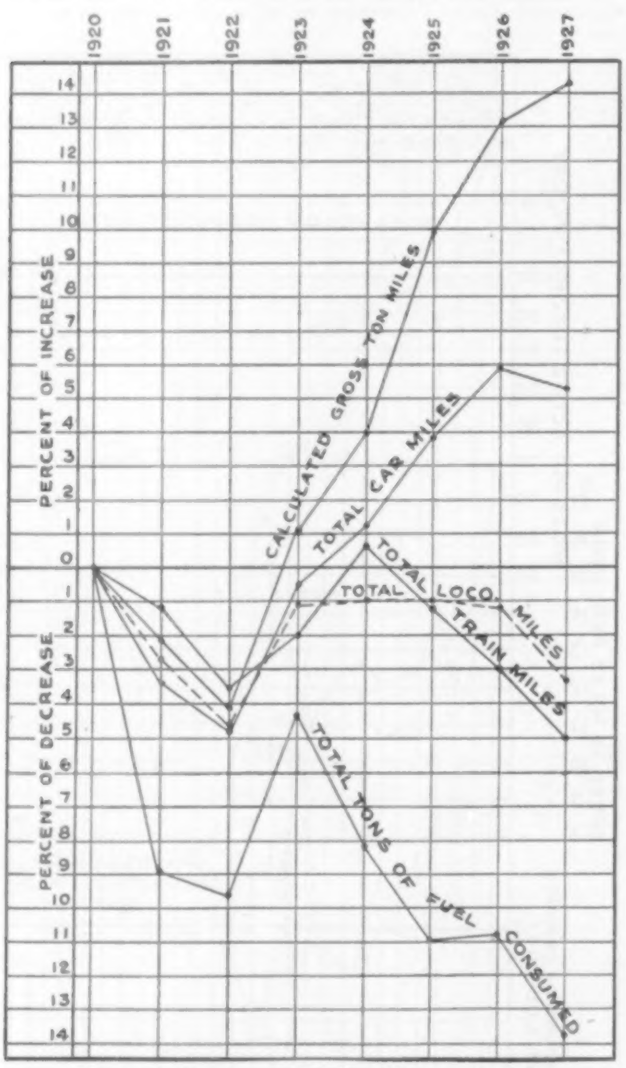


Chart H—Passenger Service Volume Trends

cludes unserviceable locomotives stored or awaiting disposition and also locomotives awaiting or undergoing repairs if held out of service for one calendar day or more on that account. It is understood that a calendar day means the time 12 midnight to 12 midnight."

There should be no confusion as to OS-A and CS 56-A requirements. The latter is a Car Service Division report, and, so far as unserviceable units are concerned, is based on a 24-man-hour rather than a 24-clock-hour day. It is immaterial what method an individual carrier uses in reporting the power situation to its management; but for arriving at the number active, the reporting of the data on the OS-A forms should be accurate and as called for.

The miles per active locomotive day were higher in 1920 than in any subsequent period. We have endeavored to determine the reasons therefor. The present OS forms of the interstate commerce commission have been effective from January 1, 1921, and when data was reported for that year, the forms provided for comparative data of the preceding year. The counting of the number serviceable, unserviceable and stored in 1920 was on the OS-4 basis, since abolished. For this reason the number active in 1920 was not relative. The comparison from 1921 to 1927 inclusive is somewhat accurate except for variations in interpretation of the OS instructions.

Performance of Selected Individual Carriers

Your committee has issued quarterly and annual reports and statistics, including 26 individual carriers. Chart F (not shown) gives their performance as to gross ton miles per train hour, gross tons per train, and train speed, comparing 1927 with 1920. The gross ton miles per train hour for 1920 were arranged from the higher to the lower performance, and all other data shown in relation thereto. A high factor of gross ton miles for train hour can be attained by either a high tonnage per train and low speed, or a low tonnage per train and high speed, and the chart shows considerable variation between carriers in this respect.

Chart G shows the miles per active locomotive day, train speed in miles per hour and the equivalent daily hours of service per active locomotive day, comparing 1927 with 1923. Only four of the 26 carriers exceeded 100 miles per day in 1927, and in that year six of these carriers made less mileage per day than in 1923. Twelve of these carriers made less mileage per day than the average for Class I Carriers in 1927. The chart indicates the 11 carriers investigated by your committee.

Chart G further shows the train speed in miles per hour, comparing 1927 with 1923. In every case there has been an increase in train speed.

Twenty of the 26 carriers reduced the hours of service per day by increasing train speed. The six carriers showing an increase in hours per day had an increase in miles per day in excess of the increase in speed. It is possible to increase the miles per active locomotive day without increasing the speed or hours of service, so far as this method is concerned, by double or triple crewing locomotives, the objective being to reach at least 100 miles per day in eight hours of service. At the same

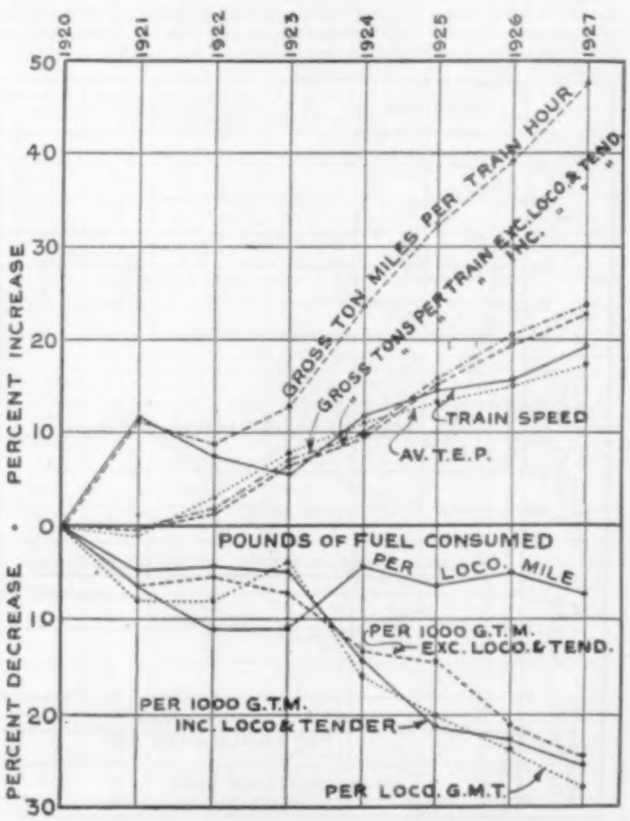


Chart 2—Trends of Important Fuel Factors

time the chart indicates that while there has been an improvement, advantage has not been taken of either reducing the number of locomotives in service or producing longer freight locomotive runs, which in both cases would give more nearly eight hours of continuous service per day.

Passenger Service Volumes

The passenger service volumes for Class I carriers ranged as shown in the table in these periods, including total gross ton-miles, calculated as explained later.

Passenger Train Performance

	Gross tons miles (Millions)	Train miles (1,000)	Locomotive miles (1,000)	Car miles (Millions)	Fuel Tons (1,000)
1920.....	237,868	567,705	583,774	3,580	33,671
1921.....	232,607	560,499	567,848	3,460	30,658
1922.....	228,005	546,798	557,338	3,405	30,430
1923.....	240,861	556,261	577,101	3,575	32,226
1924.....	247,507	571,060	577,876	3,632	30,806
1925.....	261,447	574,609	577,728	3,717	29,910
1926.....	269,399	550,710	576,771	3,793	30,015
1927.....	271,805	539,297	564,015	3,770	28,988

The increases in volumes were in calculated gross ton miles and in car miles. Train and locomotive miles and tons of fuel consumed decreased. The percentages of increases and decreases in this item for each year as compared with 1920 are illustrated on Chart H. No data is available for train speeds or train hours.

The unit performances for miles per active locomotive day, cars per train, tons per train (calculated), and pounds of fuel per car mile, per locomotive mile and per 1,000 calculated gross ton miles are also shown in one of the tables.

Unit Performance of Passenger Locomotives

	Miles per active loco. day	Cars per train	Ave. tons weight per car	Ave. tons per train	Pounds fuel per car mile	Pounds fuel per loco. mile	Pounds fuel per 1000 g.t.m.
1920...	*	6.5	64.32	419.08	18.8	116.0	282.0
1921...	142.1	6.4	64.82	414.85	17.7	108.0	264.0
1922...	140.2	6.4	65.15	416.96	17.9	108.0	266.0
1923...	142.6	6.5	66.63	433.09	18.1	110.0	267.4
1924...	143.0	6.6	65.59	432.89	17.0	106.0	248.8
1925...	147.7	6.7	67.89	454.86	16.1	103.6	228.8
1926...	151.9	6.9	71.13	490.97	15.8	104.0	222.2
1927...	154.0	6.99	72.10	503.98	15.4	102.6	213.2
1927 and 1920							
Percent inc......		7.5	12.10	20.2	...	....	....
Percent dec......		..	....	....	19.8	11.6	24.4

*Not available

The miles per active locomotive day increased 8.3 per cent from 1921 to 1927. The number of cars per train and the average weight per car resulted in an increase in average tons, excluding load carried, of 20.2 per cent. The fuel performance shows a marked decrease.

The weight per passenger train car was the result of an investigation of one carrier, and this weight times the average number of cars per train for Class I carriers gave the tons per train, which result, times the train miles in each year, gave the trailing gross ton miles used for trend purposes.

Inquiry was made of all voting locomotive members as to the number of continuous passenger locomotive runs of more than one crew, the same as explained for freight locomotives, and the results of replies were as follows, as of June 30, each year, except January 31 for 1928:

	6-30-25	6-30-26	6-30-27	1-31-28
No. of two-crew runs........	870	1011	1141	1187
No. of three-crew runs........	213	256	274	288
No. of four-crew runs........	65	93	90	78
No. of five-crew runs........	19	17	20	28
More than 5-crew runs.......	4	4	4	10
Totals.................	1171	1381	1529	1591

This shows a much larger number of extended runs in passenger than in freight service.

The following table shows the number of passenger locomotives reported owned and the condition thereof.

Condition of Passenger Locomotives

	Total		Unserviceable		Serviceable		Stored		Active	
Year	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1921	15,066	100	3,479	23.4	11,587	76.6	644	4.0	10,943	72.6
1922	14,993	99.5	3,521	23.5	11,472	76.5	606	4.0	10,866	72.5
1923	14,555	96.6	3,033	20.8	11,522	79.2	433	3.0	11,087	76.2
1924	14,554	96.6	2,679	18.3	11,865	81.7	794	5.4	11,071	76.3
1925	14,341	95.2	2,554	17.8	11,789	82.2	1,036	7.3	10,753	74.9
1926	13,882	92.1	2,365	17.1	11,517	82.9	1,109	7.9	10,408	75.0
1927	13,511	89.7	2,220	16.4	11,291	83.6	1,257	9.3	10,034	74.3

The proportionate number unserviceable shows a consistent decrease, but the number stored has not increased sufficiently to reduce the proportion of active units as much as desired. The total number of units was 10.3 per cent less in 1927 than in 1921, and the number active was 8.3 per cent less. Further improvement in this respect must come from increasing the daily number of units active to a greater extent than the decrease in total locomotive mileage.

The method of counting the number stored and active is the same as for freight service. The same recommendations made as to counting apply likewise.

To indicate what has been accomplished in miles per active locomotive day by the 26 carriers listed, Chart I shows the miles per active passenger locomotive day in 1927 compared with 1923. This shows that carriers with a high mileage are continuing to improve their performance. The higher mileage was 297.8 and the lower 113.4 in 1927. This represents a wide range and shows what is attainable.

Yard Service Performance

The utilization of yard power deserves much attention, as it appears that there is much room for improvement. Few statistics are available as to yard locomotive performance, and it has been necessary to resort to the CS 56-A, Car Service Division reports, to obtain trends, it being understood that this source is on a slightly different basis of counting than the OS-A and OS-B reports. The data thus used is shown in the table.

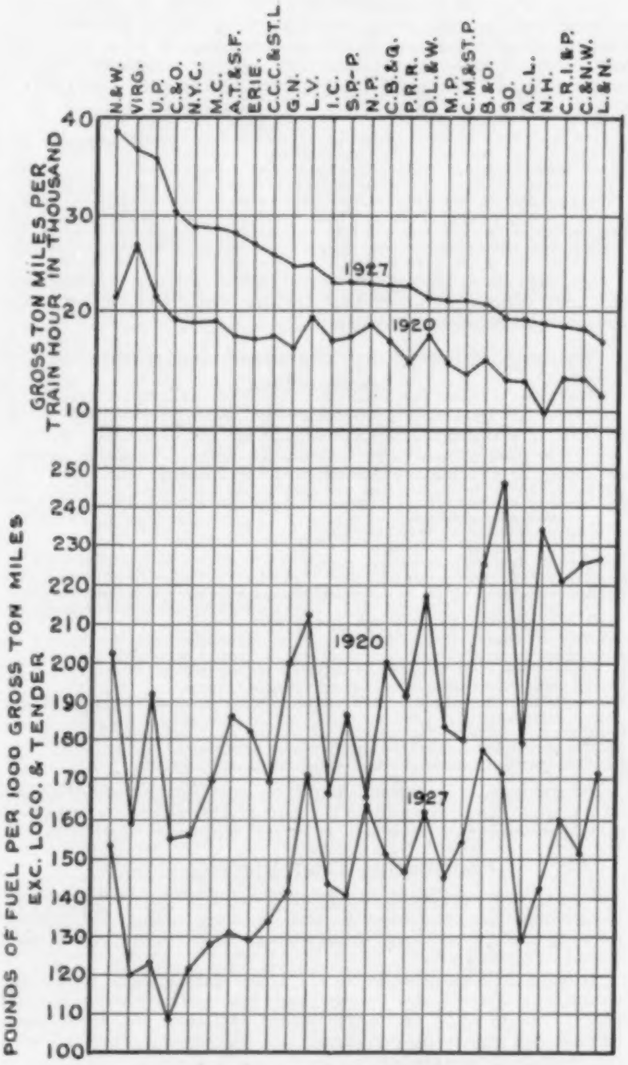


Chart 3—Pounds of Fuel per 1,000 Gross Ton-miles and Gross Ton-miles per Train-hour for Selected Carriers

Yard Locomotive Performance

	Total miles (1000)	Total hours (1000)	Total shifts (1000)
1923.....................	342215	57036	7129
1924.....................	315897	52649	6581
1925.....................	324208	54035	6754
1926.....................	339657	56610	7076
1927.....................	......	.....	....

The total miles reported were divided by six (six miles per hour-arbitrary), and this result by eight (eight hours per shift), to indicate equivalents. When taking the number of yard locomotives as reported, the condition of power, the hours, miles and shifts per active locomotive day are as given in the table.

Yard Locomotive Conditions

	Total	Serviceable	Unserviceable	Stored	Active
1923........	15592	13463	2129	630	12833
1924........	15963	13643	2320	784	12859
1925........	15978	13857	2121	830	13027
1926........	15899	14115	1784	774	13341
1927........	15603	13849	1754	1367	12482

	Miles per active loco. day	Hours worked per active loco. day	Shifts worked per active loco. day
1923............	73.0	12.16	1.52
1924............	67.3	11.20	1.40
1925............	68.1	11.35	1.42
1926............	69.7	11.60	1.45
1927............	....	....	....

The shifts per day are more than an average of one, but less than two. If two shifts per day were the average, the miles per day would be 96, and further economies in fuel and cost of repairs per mile run would be effected.

Inquiry was sent to members as to the number of locomotives working one, two and three shifts per day, and as this was not a matter of previous record, it is assumed replies were based on only selected yards and calculations, giving somewhat higher results than the averages shown in the foregoing. The results of this inquiry were as follows, for a single day:

	6-30-25	6-30-26	6-30-27	1-31-28
Working				
One shift	4136	4176	4020	3909
Two shifts	3460	3658	3627	3581
Three shifts	1580	1735	1727	1783
Average shifts	1.71	1.74	1.75	1.76
Average hours per day	13.68	13.92	14.00	14.11
Average miles per day	82.08	83.52	84.00	84.67

This data shows progress in utilization of yard locomotives and your committee urges that further study be given to still greater utilization in larger yards.

Savings Effected by Increased Utilization of Locomotives

During the past year your committee gave consideration to a method of arriving at economies effected by increasing utilization of locomotives. In most cases, the factors in which economies may be effected are shown in the following:

A—Number of locomotives eliminated from assignment as a result of increased utilization.
B—Cost of interest on investment.
C—Cost of taxes on investment.
D—Cost of depreciation on investment.
E—Cost of locomotive repairs.
F—Apportionment of M. of E. miscellaneous accounts (Accounts 301, 302, 304, 332, 333, 334, 335, 336 and 337), to locomotive repair accounts (Accounts 308 and 311).
G—Apportionment of shop maintenance to locomotive repairs.
H—Apportionment of deadhead haul on locomotive material.
I—Apportionment of interest on material stocks reduced.
J—Enginehouse expense—total direct charges thereto.
K—Apportionment of M. of E. miscellaneous accounts to enginehouse expense.
L—Terminal mileage eliminated.
M—Proportion of locomotive supplies and lubrication.
N—Fuel saved resulting from dispatchments eliminated.

Net savings in expenses, therefore, resulting from saving in locomotives (Item A) will be the sum of Items B to N, inclusive, calculated either on monthly or annual basis.

Locomotive Fuel Performance

During the past year the joint committee on Utilization of Locomotive was instructed to take up the work of the former joint committee on Fuel Conservation, and this report is submitted accordingly.

In order to illustrate the trend of fuel performance your committee has charted the volume and unit performances for the years 1920 to 1927, inclusive, where available, and made comparisons on charts by percentages of increase or decrease with the year 1920 as the base.

The statistics for freight and passenger service fuel performance have been issued in quarterly and annual reports of the joint committee on Utilization of Locomotives and cover performance of Class I carriers from 1923 to 1927 inclusive.

Volume of Fuel Consumption

One of the tables shows the total tons of fuel consumed each year by locomotives in freight, passenger and yard service.

Tons of Coal Consumed by Locomotives

	In freight service (1000)	In passenger service (1000)	In yard service (1000)
1920	89,925	33,671	24,338
1921	69,939	30,658	18,237
1922	75,694	30,430	19,495
1923	90,033	32,226	24,068
1924	81,025	30,806	21,974
1925	81,316	29,910	22,176
1926	85,095	30,015	23,269
1927	80,416	28,988	*

*Not available as yet.

The percentages of increase or decrease are illustrated on Chart I (not shown). These indicate that the total consumption in passenger service has been decreasing more constantly than in freight and yard service, due to the fact that passenger service is more uniform and improvements in consumption follow accordingly. Since the major portion of yard service is in freight train work, the volumes of consumption fluctuate correspondingly, except that since 1923 the reductions in yard service have been less than in freight road service, due to the fact that since 1923 there has been a marked increase in train tonnage, carrying with it an increase in the relative amount of yard work necessary.

Unit Freight Service Consumption

The factors of train speed and tonnage in relation to fuel consumption are shown below. The table shows the gross tons per train, both including and excluding locomotive and tender, the train speed and the resultant gross ton miles per train hour from 1920 to 1927 inclusive. In relation thereto, the trends are shown in pounds of fuel per thousand gross ton miles, both including and excluding locomotive and tender, and the difference between these two to indicate the consumption of locomotive and tender only, expressed in thousand locomotive and tender gross ton miles. The trends of consumption per locomotive mile are also shown.

Trend of Fuel Performance in Freight Service

	Gross tons per train			Gross ton miles per	Pounds per 1000 g.t.m.			Pounds per
	Exc. loco.	Inc. loco.	Train speed	train hour	Inc. Loco.	Exc. Loco.	Loco. Only	loco. mile
1920	1649	1443	10.3	14877	170	197	25	252.0
1921	1640	1435	11.5	16555	162	185	23	235.6
1922	1667	1464	11.1	16188	163	186	23	224.2
1923	1751	1539	10.9	16764	161	183	24	234.2
1924	1807	1588	11.5	18257	149	170	21	240.6
1925	1897	1670	11.8	19679	140	159	19	235.8
1926	1969	1736	11.9	20705	137	155	18	238.2
1927	**2018**	**1780**	**12.3**	**21945**	**131**	**148**	**17**	**233.2**

The trends in percentages of increase or decrease each year compared with 1920 are illustrated on Chart 2. The increases in train speed and average tractive effort pounds per locomotive (the latter in addition to Table No. 2), were quite relative, the speed increase being slightly in excess of the average hauling power. The gross tons per train, both including and excluding locomotive and tender, show relative trends of increase, the trailing tonnage increasing slightly more than the total tonnage including locomotive and tender, indicating an increase in tonnage hauled more than increase in locomotive weight.

The increases in performance were accompanied by decreases in fuel consumption. The decreases in consumption per thousand gross ton miles, both including and excluding locomotive and tender, were quite relative to the increases in unit train factors. The decreases applied to the locomotive ton miles were also relative. The pounds of fuel per locomotive mile did not decrease relatively, but were in all cases less than 1920, in spite of the greater trailing load and speed. Your committee has not attempted to define the economical load and speed factors, as local conditions vary too much. The train speed of 12.3 miles per hour apparently is not such, in relation to the average tonnage per train for Class I carriers, as to increase consumption of fuel per thousand gross ton miles. Apparently the speed and tonnage increases indicate that the reductions in fuel consumption have not yet reached their lowest point.

Chart 3 shows the relative performance of the 26 carriers listed in the quarterly reports, in gross ton miles per train hour to indicate the combined factors of speed and train tonnage, and the consumption of fuel in pounds per 1,000 gross ton miles. The trends show the tendencies for fuel consumption to increase as the train factors decrease, the variations in fuel consumption from the gradual trends being due to local conditions, such as curvatures, grades, quality of water and fuel, character of power as to size, design, etc.

Passenger Service Volume Performances

The volumes of traffic and fuel, comparing each year with 1920, consist of total car, train and locomotive miles, calculated gross ton miles, and tons of fuel consumed. These are shown in Table No. 6 of the report on Utilization of Locomotive.

The trends in percentages of increase or decrease compared with 1920, are shown on Chart H of the report on Utilization of Locomotives. The gross ton miles are the product of cars per train times average weight per car (obtained from our investigation of one carrier, excluding weights carried), and this times the train mileage for each year. Since 1923 the decreases in tons of fuel consumed were relatively inverse to the increases in gross ton miles.

Unit Passenger Service Performances

For Class I carriers the unit performances were as follows:

Unit Fuel Performance in Passenger Service

	Cars per train	Tons per train	Pounds of fuel per Car mile	Loco. mile	M. ton mile
1920	6.5	419	18.8	116.0	283.0
1921	6.4	415	17.7	108.0	263.0
1922	6.4	417	17.9	108.0	266.6
1923	6.5	433	18.1	110.0	266.6
1924	6.6	433	17.0	106.0	248.8
1925	6.7	455	16.1	103.6	228.8
1926	6.9	491	15.8	104.0	222.8
1927	6.99	504	15.4	102.6	213.2

The percentages of increase or decrease for each year compared with 1920 are shown on Chart No. 4. This shows that the pounds of fuel per car mile and per locomotive mile have continued to decrease, particularly since 1923, somewhat in inverse relation to the increase in tons and cars per train. The reduction in fuel consumption has been accomplished by improvement in design and type of power, increased utilization, and more intensive fuel conservation methods.

Yard Service Volumes

The yard service locomotive mileage is based on six miles per hour, so that the hours of service and shifts are available. The table shows the total yard locomotive miles, hours of service per year, and equivalent number of eight-hour shifts, compared with the total tons of fuel consumed.

Volume of Yard Locomotive Service

	Total yard locomotive miles (1000)	Total yard locomotive hours (1000)	Total equivalent number of 8 hour shifts (1000)	Total tons fuel consumed (1000)
1920..........	356,947	59,491	7,436	24,338
1921..........	264,596	44,099	5,512	18,237
1922..........	284,161	47,193	5,899	19,495
1923..........	342,215	57,036	7,129	24,068
1924..........	315,897	52,649	6.581	21,974
1925..........	324,208	54,035	6 754	22,176
1926..........	339,657	56,610	7,076	23,269
1927..........	*	*	*	*

*1927 not available.

The total miles, hours and shifts have been less each year than in 1920, and the fuel consumption has not decreased in the same proportion. In 1927 the total mileage was 4.8 per cent less than in 1920, but the total fuel consumption was only 4.3 per cent less, so that much remains to be done in reducing the amount of fuel consumed. It is felt that by working more hours, shifts and miles per day, a fuel saving will be accomplished.

Unit Yard Locomotive Fuel Performances

The unit fuel performances by years are derived from the miles, hours and number of shifts per day, from 1923 to 1926 inclusive, as the number of locomotives active to obtain the number of shifts, miles and hours per day is not available for prior years. The results are included in a table.

Unit Fuel Performance of Yard Locomotives

	Pounds of fuel per active locomotive			
	Mile	Hour	Shift	Day
1920................	136.4	....	.....	.....
1921................	137.8	....	.....	.....
1922................	137.2	....	.....	.....
1923................	140.7	844.2	6753.6	10265.5
1924................	139.1	834.6	6676.8	9347.5
1925................	136.8	820.8	6566.4	9324.3
1926................	137.0	822.0	6576.0	9535.2
1927................	*	*	*	*

*1927 not available.

The pounds per mile times six miles per hour gave the hourly consumption, and this result times eight hours per shift gave the consumption per shift. The consumption per shift times the average number of shifts per active yard locomotive day, as shown in the report on utilization of locomotives, gave the consumption per active locomotive day.

Much may be accomplished in reducing yard fuel consumption by reducing the number of yard locomotives in service, working each locomotive in active service a larger number of shifts per day, or approximately two or more instead of less than 1.5. This reduces the frequency of cooling down and firing boilers, boiler washing, and minor repairs, so that there should be a saving in the cost of repairs per mile run as well as in fuel.

The report of the joint committee on Fuel Conservation in the 1920 Proceedings covers recommended practice for Fuel Economy on Locomotives. The association published the recommended practice in booklet form and have copies available at a nominal cost.

Your committee recommends an adequate organization to supervise the inspection, distribution and use of fuel on each railroad, having in mind that the activities of this organization will extend into various departments that have to do with the use of fuel.

There is appended hereto a list of items for observation and supervision in relation to fuel conservation, divided to show those applying to the transportation, operating, engineering and mechanical departments, and locomotive crews.

Problems Effecting Fuel Economy

Transportation

1. Accurate loading of locomotives to their rated capacity.
2. Empty car movement avoiding rehauling or rehandling.
3. Open freight car doors on trains en route.
4. Locomotive furnished with fuel as near source of supply as possible.
5. Transportation of fuel.
6. Routing of dump bottom coal cars to chutes equipped with dumping facilities and flat bottom cars to shovel chutes.
7. Diversion of fuel in transit.
8. Loss of coal falling through cracks when shipped in stock cars.
9. Have switch list ready, small yard listing all cars from one first out, designating whether load to go or empty.
10. Have truck for baggage properly located to reduce delayed time at station to a minimum.
11. Load cars to capacity if possible. Avoid loading in two cars with a shipment that could be loaded in one.
12. Remove all foreign material when loading cars.
13. Enter correct tare weight on way bill, also accurate weight of commodity and ice if refrigerated.

Operating

14. Extension of locomotive runs.
15. Proper distribution of time on time card schedules.
16. Dispatching that will avoid as far as possible slowing down, stopping or delaying trains.
17. Double heading engines and light mileage.
18. Avoid slow orders as far as possible and prompt removal of same when cause is taken care of.
19. Detention of trains on sidings.
20. Stopping tonnage trains enroute to spot cars or do switching.
21. When consistent use 19 orders instead of 31 orders.
22. Avoid stopping trains unnecessarily, especially freight trains.
23. Handle signal and order boards promptly.
24. Operation of fuel stations with proper handling of fuel to avoid separation of lumps and slack and reduce breakage.
25. Storage of coal and selection of coal for storage.
26. Facilities for storing coal for station heating under lock and key.
27. Proper draining of tank cars of oil when they are made empty.
28. Waste of coal around coal chutes and yards.
29. Facilities for storing and properly protecting smithing coal and coke.
30. Furnishing of coal of uniform quality on each operating Division.
31. Proper handling of steam heat and ventilator equipment on passenger trains.
32. Loss of coal enroute due to dump doors on cars not being closed.

Terminals

33. Train makeup as to location of loads and empties and braking power.
34. Ordering engines for trains.
35. Detention of engines or trains in yards.
36. Switching in yards, advantages taken of grades and traffic.
37. Switching out bad order cars with road engine.
38. Yard air line facilities to expedite the testing of brakes on cars in train yard.
39. Advance yard track to head in on to avoid stopping train.

Engineering and Maintenance

40. Lengthening of passing tracks.
41. Location of signals, new and others, adjusted for clear view.
42. Location of water tanks.
43. Location of fuel stations.
44. Arrangement of heater coils at oil handling facilities so that condensation will drain out of the coil instead of the coil filling up with water.
45. Facilities for re-claiming oil that falls into pits at terminals.

Mechanical

46. Assignment of power that is suitable for service to be performed.
47. Storing of less efficient power when business falls off and keeping of more efficient power in service.
48. Air brake leaks, brakes sticking on cars enroute or hand brakes set.
49. Steam heat hose connection leaks, and adjustment of drip valves and tail hose valves.
50. Proper maintenance and handling of steam heat equipment on locomotives.
51. Drafting of locomotives and proper alignment of draft appliances.
52. Efficient front end arrangement and size of nozzles.
53. Properly fitted grates.
54. Instruction and training of new firemen.
55. Locomotives popping in round house or on outside tracks.
56. Closing of dampers and cover placed on stack when necessary to hold locomotives under steam for a period of time. Also, on oil burning locomotives, fire should be extinguished.
57. Keeping locomotives under steam several hours before using.
58. Waste of coal and coke in blacksmith shop.
59. Steam, water and air leaks in round houses, car yards and train yards.
60. Facilities in roundhouse for taking care of all power, eliminating the necessity of locomotives being fired up and set outside for any length of time, especially during cold weather.
61. Operation of direct steaming and hot water boiler washout plants to secure best results to be obtained from such equipment.
62. Treatment of boiler waters.
63. Fuel oil heaters leaking or wasting steam.
64. Furnishing of sand in proper condition to clean soot out of oil burner boilers.
65. Turning out fires as soon as possible after locomotive reaches terminal.
66. Oil leaks in piping between tank and burner.
67. Fuel oil tanks leaking.
68. Excessive use of blowers during time that fire is being knocked.
69. Locomotives standing on cinder pits keeping them under steam before being taken into roundhouse.
70. Cleaning of fires.
71. Washing of boilers.
72. Cleaning out of flues.
73. Smoke box and outside steam pipe casing air leaks.
74. Air leaks around fire pan and mud ring on oil burning engines.
75. Fire door openers, brick arch, grate shaker rigging and stoker maintenance.
76. Miscellaneous steam leaks, such as throttles, whistle valves, pops, piston and valve stem packing, cab valves, mud rings, etc.
77. Power reverse gear maintenance.
78. Maintenance of cylinder and valve rings.
79. Proper heating of fuel oil.
80. Proper use of atomizer, oil heater and blower.
81. Alignment of burners.
82. Proper distribution of heat in fire boxes of oil burning engines.
83. Arrangement of brick work.
84. Furnishing clean sharp sand and proper use of it to prevent locomotive from slipping.
85. Check of work reports to see that work reported on locomotive is properly done.
86. Attention in firing up process in order to furnish locomotive with fire in good condition.
87. Use of scrap lumber and old ties in firing up coal burning locomotives, thereby reducing quantity of coal used.
88. Heavy clinkered fires leaving terminals.
89. Air openings in ash pan to admit enough air to burn fire evenly over grates.
90. Proper arrangement of air openings in fire pan of oil burners.
91. Removal of fuel from tenders of locomotives that are stored.
92. Overloading tenders at coal chutes and oil racks.

Engineers and Firemen

93. Methods of firing locomotives.
94. Methods of running locomotives to develop maximum power from the steam used. The use of valve chest—back pressure gauge is helpful in bringing this about.

95. Working of injector to supply water to boiler as near as possible to rate it is being used. Avoid putting large quantities of water in the boiler at one time while standing.
96. Lubrication of all parts of locomotives.
97. Locomotives popping while on road.
98. Handling of grate shakers, improper methods resulting in shaking unburnt coal into ash pan.
99. Excessive use of blower causing waste of steam; also results in flues leaking.
100. Proper blowing out of boilers.
101. Carrying water at proper level to get maximum efficiency out of superheaters.
102. Intelligent reporting of necessary work on locomotives.
103. Coal falling through gangway due to firing deck not being kept clean.
104. Headlight dynamo running during day time.
105. Locomotives turned in at roundhouse pits with heavy fires.
106. Waste of steam through stoker steam jets by not shutting jets off when stoker is not running.
107. Proper use of cylinder cocks to relieve condensation from cylinders of locomotives, thus avoiding damage to cylinder and piston packing which, if defective, will waste steam.

POWER PLANTS, HEATING AND PUMP PLANTS AND USE OF LIGHTS

108. Efficient operation of station stoves.
109. Proper ventilation of offices and stations.
110. Unnecessary use of electric lights.
111. Facilities for storing and properly protecting coal and coke for heating of buildings, power and pump houses.
112. Maintenance of power plant boilers in order that steam may be generated economically.
113. Efficient use of steam generated in power plants.
114. Use of exhaust steam for heating.
115. Use of vacuum return system in heating plants.
116. Firing of power plant boilers.

PURCHASING AND INSPECTION

117. Proper loading of fuel in cars at the mine or loading rack.
118. Proper billing of cars so that the fuel will be used for the purpose intended.
119. Showing of correct net purchase amount of fuel on waybill.
120. Frequent check-weighing or check-measuring of fuel in cars at destination, to see that fuel purchased is being received.
121. Proper preparation of coal as to size and removable impurities.
122. Use of specifications for different kinds of fuel that will insure fuel suitable for service to be performed.
123. Inspection and testing of fuel to see that it conforms to specifications.
124. Purchase of satisfactory fuel that will give the lowest cost per unit of work.

The report was signed by the following:

Representing the Operating Division: T. B. Hamilton, vice-president, Western region, Pennsylvania; J. T. Gillick, chief operating officer, Chicago, Milwaukee, St. Paul & Pacific; and A. E. Ruffer, transportation manager, Erie.

Representing Mechanical Division: W. H. Flynn, general superintendent motive power and rolling stock, New York Central; O. S. Jackson, superintendent motive power and machinery, Union Pacific; and O. A. Garber, chief mechanical officer, Missouri Pacific.

Discussion

George Goodwin (C. R. I. & P.): I would like to question the committee in regard to chart F showing gross ton miles per train hour, in thousands. That is influenced largely by the size of the locomotive. For instance, the Virginia, apparently is making the best performance. Would it be possible to show that information with relation to the average sized locomotive on the road. For example, a road may make a good performance in gross ton miles per train hour due to being efficient, or it may make it because it has big power. Of course I assume that both reasons apply in the case of the Virginian.

Mr. Nicholson: Tons per train is usually a factor of locomotives size, and gross ton mi. per train-hr. is a combined factor of tonnage and speed, so that increased tonnage per train incident to larger power would affect the information reflected in the graph. The information as to gross ton mi. per unit of tractive force can be worked out, if the information for the individual railroad is available. The committee, however, does not have that information for an individual carrier. If it is available for any railroad, it can be applied on the basis that you speak of.

W. H. Flynn (N. Y. C.): The committee would like to receive the benefit of your comments and criticisms. There has been a lot of work done in preparing this report, and you may not agree with all the statements and figures that are quoted. If you do not agree, we would like to know why you don't agree.

You must remember that this committee is a joint committee composed of representatives of the operating department as well as mechanical department, and consequently the responsibility of securing improved performance year by year is divided. But assuming that the proper co-operation exists between both departments, as it should, and as I am willing to assume it does, we should year by year be able to accomplish something a little better than was done the year before.

The report generally shows that favorable results are being accomplished, but there is one report, or one table in here that is not very favorable. Why is there so much unproductive time for locomotives? Mr. Demarest touched on that subject, and it is one that can be enlarged on in various ways; but it does seem as though we should have a more favorable performance today than we had five or six or seven or eight years ago. It is true the locomotives are larger. There are more appurtenances on them, and they require more work to maintain. But is that sufficient justification for the locomotive laying in the enginehouse any longer than it did before? Should we not have improved our organization to take care of those various appliances and the additional size of the locomotive? Assuming that has been done, then why should the unproductive time remain the same, or even be slightly greater? It looks very much as though it were the result of keeping too many locomotives in service.

A lot of thought and study has been given to that subject on the railroad with which I am connected, and we have found in many cases that we could reduce the number of locomotives in service by repairing them promptly, conferring with the operating department, and co-operating with them in every way possible. We should be able to reduce the locomotive hours in engine terminals. I believe it can be done, and I hope that when the 1928 figures are compiled and presented at a subsequent meeting we will have a substantial reduction in the number of hours that locomotives are out of service. It can be done by co-operation.

It is my opinion that the mechanical department cannot in all cases control the number of locomotives that are in service, or held for service, but if what this results in can be brought home, through co-operation and conference with your operating friends, I think I would be safe in predicting that subsequent reports in this respect will be more favorable.

Mr. E. B. Hall (C. & N. W.): I want to suggest that the committee in next year's analysis give some study to road conditions, and if there is a road on which they are making comparisons, call for the chief mechanical officer of that railroad to give them some information as to the characteristics of the road, or the conditions which prevent them increasing their engine runs. We have made studies not only on the Northwestern but on other railroads that have extended runs, to find out the economies effected and the results obtained.

We found different methods on nearly every railroad that we observed. The time schedule and the train is a factor that cannot be lost sight of. The terminal facilities on such divisions or railroads where the time is short is another item that must be taken into consideration. If your schedules are such that you are cramped by them, you cannot very well stop between terminals or at points where you are not doing the station work to take coal, water, and still maintain your schedules, and the service.

We discovered in our investigations of the reports of savings effected by the continuation of engine runs where terminals were eliminated that in many instances if you check the payroll, the men are on at some other point, and a real saving is not effected.

The question that Mr. Flynn referred to, with regard to reduction of locomotives and runs, is, I believe, reflected by the arbitrary trains on many divisions of different railroads, the decrease in business, and the extent that time trains or arbitrary trains are handling all of the business. These trains must be run on account of various connections that they make, whereas, if you had more business, you could handle more tonnage, and do it with the same number of engines.

Mr. Hall: I move that the report be received and placed in the records.

Chairman Smart: There may be some portions of this report that should be referred to the general committee.

Mr. Flynn: The comparison of stored locomotives has created some embarrassment to some railroads. The published figures not being formulated on a uniform basis, make discrepancies which are difficult to explain. This may not be just what you want, but it puts it on a comparative basis for all railroads; it does not interfere with any local arrangements you may have on your respective railroads for reporting locomotives that are stored, but for reports published by the intestate commerce commission it does place them on a comparable basis, and that is the reason it was found advisable to recommend changing the definition of a stored locomotive.

Mr. Hall: I think your statement is correct. We have been reporting, but we haven't been reporting the way we have been keeping information. I will include Mr. Flynn's suggestion in the motion.

(*The motion was seconded and carried.*)

(*The meeting then adjourned.*)

Division VI Elects Officers

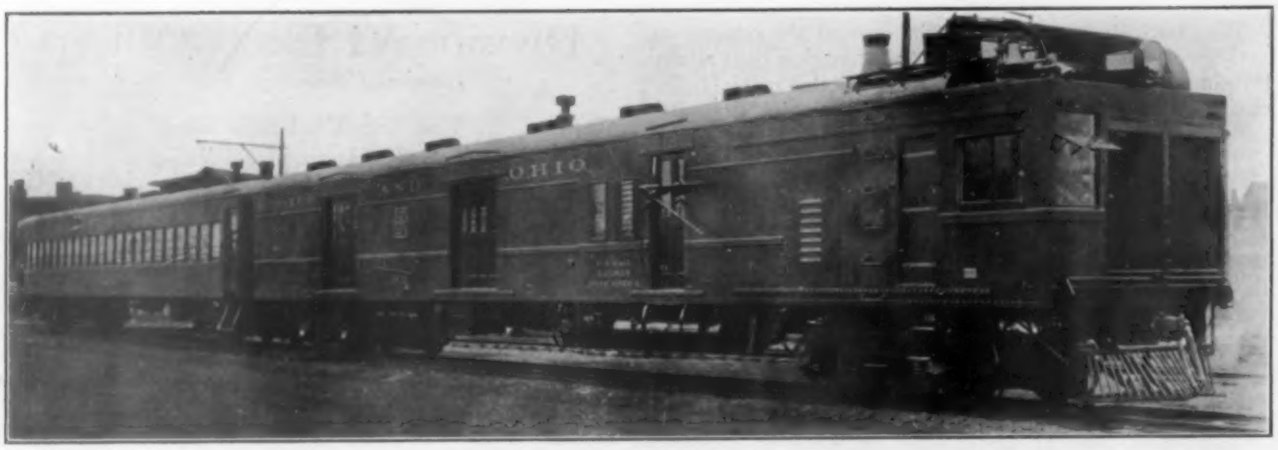
(*Continued from Page 1490D5*)

The Vice-Chairman Elect

Mr. Davidson was born in Selma, Ala., and was educated in the public schools at Vicksburg, Miss. He served an apprenticeship in steam and gas pipe fitting and entered railway service in 1893 as a car repairer on the Yazoo & Mississippi Valley, now operated by the Illinois Central. Thereafter, he was employed in various clerical capacities in the stores work until June, 1908, when he was appointed division storekeeper at Vicksburg. He was advanced to asistant general storekeeper of the Illinois Central Lines May, 1910, and promoted to general storekeeper, May 1, 1917. Many improvements have taken place in stores conditions on that road since that time and he prides himself upon the business-like methods with which he administers his work. Ask him anything about his turnover or his labor costs and see how quickly he can answer.

Like Mr. Kyle, Mr. Davidson has not only been active in the division work, but has proved a leader in generously promoting on his property the practices which the Division recommends. This interest in the Division's welfare is exemplified by active service on committees, having served on the piece-work committee in 1913 and 1914, functioning as chairman of the committee on scrap handling in 1916, and serving on committees on conservation, commissary, and reclamation from 1919 to 1922. Thereafter he served as member of the general committee until his election to vice-chairman, during which period he was chairman on appointments to committees for two years, and also served as chairman ex-officio of the committee on classification of material, unit piling, line stocks, and controlling requirements.

Flood-lighting Arrangement in Modern Locomotive Erecting Shop



Mobile & Ohio Motor Car and Trailer Built by St. Louis Car Company and Equipped with Electro-Motive Double Power Plant, Total 440 Hp.

Rail Motor Cars Shown on Reading and Pennsylvania Tracks

All are gas-electric——Many with multiple-unit power plants which, with trailers, form full trains

THE rail motor cars which are shown this year on the tracks of the Reading and Pennsylvania terminals are striking examples of the marked advancements which have been made in the design of this type of railroad equipment since the 1924 or even since the 1926 convention. The widening field in which these cars have been found to be economical transportation units on American railroads, have, in most cases, made the use of mechanical transmission impracticable. As a consequence, the rail motor cars now being built for use in this country are, with few exceptions, of the gas-electric type. Most of these use gasoline, some use distilate, and a few are now equipped with multiple-unit power plants—double or triple—a clear indication of the increase in horsepower capacity requirements.

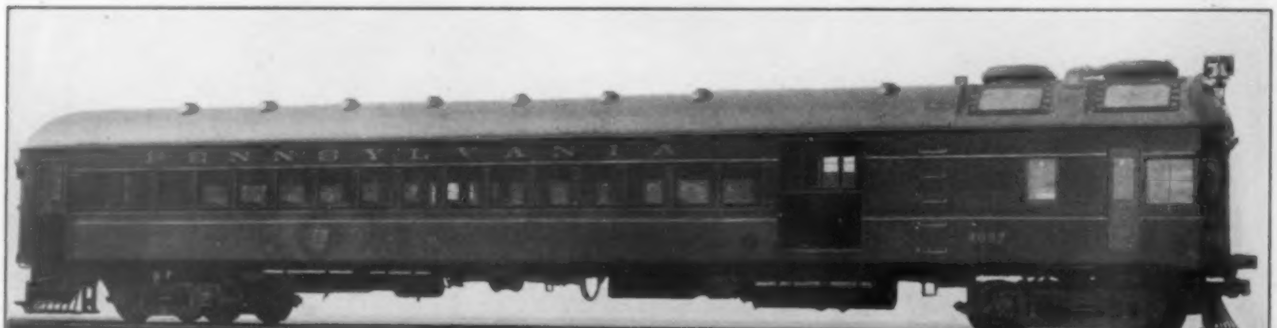
In the cars exhibited this year, it is evident that all the engineering problems involved have been considered together, and the car and its power plant designed as a unit. Even more than this, in most cases it is now necessary to consider not only the motor car in the design, but also the trailer or trailers, as the modern unit for such equipment in the complete train.

The rail motor cars and their equipment shown at the Reading Terminal, Atlantic and Arkansas avenues, includes a Mobile & Ohio train—motor car and trailer—built by the St. Louis Car Company and driven by Electro-Motive equipment; two Electro-Motive power plants placed in a New York Central automobile box car, and a Mack car with single-unit power plant.

The cars shown at the Pennsylvania Terminal, Atlantic and Tennessee avenues, include two Pennsylvania cars and two New York Central cars, all built by the J. G. Brill Company, but equipped with different power plants.

Pennsylvania and New York Central Cars

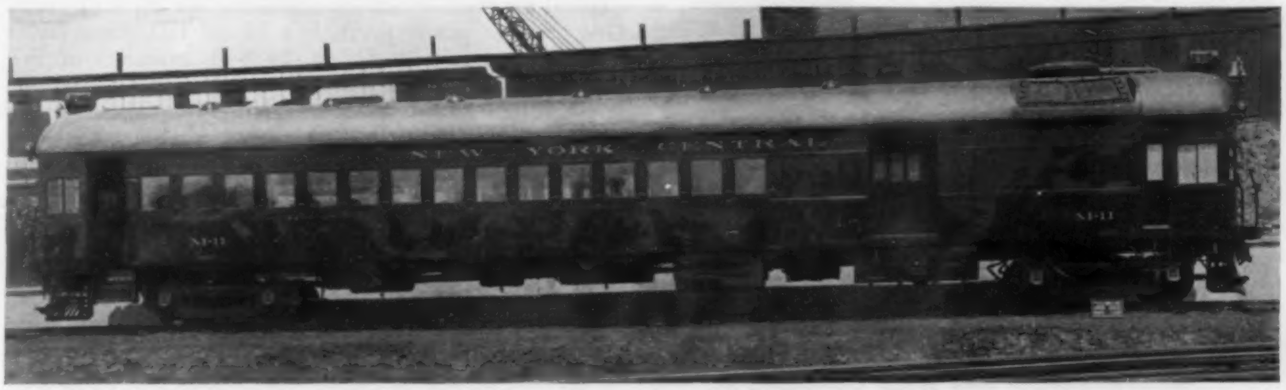
The four Brill gas-electric cars at the Pennsylvania Terminal differ in a number of important details of design and equipment. Pennsylvania car No. 4637 has a double power plant with Brill Winton engines, Model



Brill Gas-Electric Rail Motor Car for the Pennsylvania with Two Brill-Winton Engines and Westinghouse Generators of 350 Hp. Photograph Shows Circular Muffler and Exhaust System

No. 110, of 175 hp. each, at 1,200 r. p. m. The cylinders are 6 in. diameter by 1 in. stroke. The Westinghouse generator is 160 kw. and drives four Type 569-C motors. This combination car is 73 ft. long and weighs 126,750 lb. The generator fields are automatically regulated by Westinghouse torque-governor control which maintains this point. A feature of the control on both cars is the remotely controlled throttle. A small electro-pneumatic throttle device is mounted on each engine and the wires to the control coils are connected to a small throttle drum at the master controller at each end of the car.

New York Central combination passenger, smoking



New York Central Gas-Electric Rail Motor Car Built by J. G. Brill Company and Equipped with Hall-Scott 275 Hp. Engine and General Electric Generator

constant generator torque for all car speeds. This prevents the generator from overloading the engine and insures utilization of the full engine capacity over a wide variation of car speeds.

Pennsylvania car No. 4643 is equipped with Mack International Motor Company double power plant consisting of a Mack Model AQ, 120-hp. engine connected to a Westinghouse single-bearing generator. The generator field is automatic. The motor-operated rheostat is controlled directly by contacts on the engine governor. Any tendency of the engine to over-speed due to its being under-loaded is thus counteracted by the closing of the governor contacts which strengthen the generator field by operating the rheostat motor in the proper direction. Engine loading is thus kept uniform at all car speeds. The two power plants on both Pennsylvania cars are installed lengthwise, with an aisle between. A remote control is used in both cases. Remotely controlled magnetic switches are used for operating the generator field circuits and engine starting circuits. Electro-pneumatic switches and reverser are used for connecting the generators to the traction motors. The operating coils of the switches are connected to a master controller located in the operating compartment. Hazards of high voltage in the operating compartment are thus avoided, at the same time reducing the amount of apparatus at

and baggage car No. M-11 is equipped with a Hall-Scott engine of 275 hp. at 1,050 r. p. m. The cylinders are 7 in. diameter by 8 in. stroke. The engine is connected to a General Electric generator rated at 185 kw. The car is driven by two General Electric motors, 292-A, of 150 hp. each. This car is 73 ft. long and weighs 123,700 lb. The New York Central Car, M-202, is fitted with Brill-Westinghouse engine, Model 250, of 250 hp. at 1,100 r. p. m. The engine drives a Westinghouse generator, No. 176 A, rated at 160 kw. The two motors are Westinghouse No. 557 of 140 hp. each.

Among the distinctive Brill features found on these cars are the following: (1) A roof radiation which permits clear passageways around the engines and clear vision for the operator at the front of the car. With this system the water automatically drains back into the tank in the engine compartment located over a radiator connected to the car heating system, and thus eliminates the danger of water freezing in cold weather. (2) Circular muffler and exhaust system. A fan located inside of the circular muffler throws the exhaust gases high above the roof of the car, diluting it with the air driven out, thus eliminating objectionable odors inside the car. (3) Combination sliding and drop sash at operator's window. This permits either half or full opening as desired and provides a padded arm rest for

Pennsylvania Railroad Gas-Electric Rail Motor Car Built by J. G. Brill Company and Equipped with Double Power Plant, Mack Engine and Westinghouse Generator, 250 Hp.

the operator in either location. (4) Longitudinally mounted engines provide clear passageways and access to a train door in the front end for communication in double-end train operation. (5) Brill platform buffer. This new type platform buffer now used on all Brill

Mack Single-Unit Rail Motor Car Shown at Reading Terminal

gas-electric rail cars distributes shocks direct to center sills and eliminates eccentricities of buffing shocks on the coupler, thus meeting railway post-office requirements for cars with mail compartments.

The Mobile & Ohio gas-electric motor cars and trailer shown at the Reading Terminal were built by the St. Louis Car Company. The mail-baggage motor car is 72 ft. long, with a mail compartment 15 ft. 2 in. long and a baggage compartment 40 ft. long, having a capacity of 30,000 lb. of baggage. The dual power plant furnished by the Electro-Motive Company consists of two 220-hp. Winton engines direct connected to General Electric generators. The car is driven by

End View of Pennsylvania Car Showing Air Intake of Eductor Used with Mack Power Plants

four General Electric motors, No. 292. The weight of the car completely equipped is 64 tons, 40 tons being on the front truck and 24 tons on the rear truck.

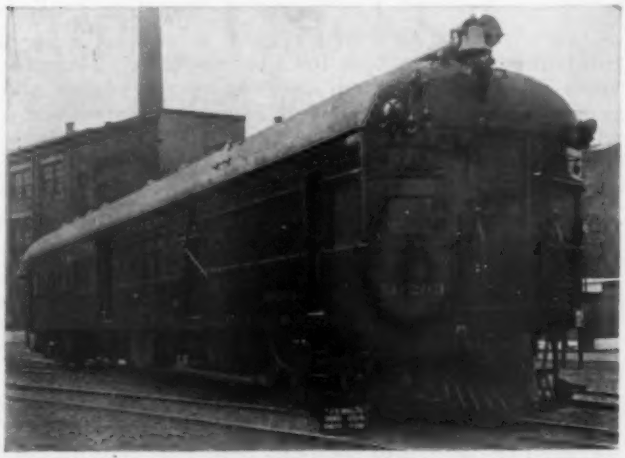
The Mobile & Ohio trailer coach is 72 ft. 8 in. long, divided into four compartments as follows: White, 55 passengers; white, smoking, 13 passengers; colored, 14 passengers, and colored, smoking, 13 passengers. The car thus has a total seating capacity for 95 persons. The seats are arranged crosswise and provide for three on one side of the aisle and two on the other side. The inside finish is in natural mahogany. Four toilets are provided. The rear of the car is fitted with an observation platform. The weight of the trailer car is 36 tons, making weight of complete train 100 tons.

Electro-Motive Company Equipment

In addition to the power plant in the Mobile & Ohio car, the Electro-Motive Company has on exhibition at the Reading Terminal two power plants in a New York Central automobile box car adjoining the M. & O. train. One of these power plants is a Model 120, six-cylinder Winton engine, with 7½-in. by 8-in. cylinders of 275 hp. at 1,000 r. p. m. The second power plant is the latest design known as Model No. 148. This consists of an eight-cylinder Winton engine of 400 hp. at 900 r. p. m. The engine is directly connected to a General Electric motor. By slight changes, the engine can be adapted for either gasoline or distilate.

Mack Single-Unit Motor Car

The Mack International Motor Company is exhibiting at the Reading Terminal a single-unit motor car. The power plant in this car consists of a Mack 120-hp. engine direct connected to a Westinghouse Type 180-A-4 gen-



New York Central Gas-Electric Rail Motor Car Fitted with Brill-Westinghouse 250 Hp. Power Plant

erator. This car is typical of a light car equipped with a single power plant and is in accordance with the Mack International Motor Company's practice of using a standard power unit and varying the number of units according to the service requirements.

The method of regulating the output of the power unit is based on the fact that the ability of an engine to accelerate under a given load is a direct indication of its ability to carry that load. Through the operation of contacts on the engine governor, which is influenced by the engine speed, a motor-driven rheostat regulates a shunt field in the generator and varies the loading placed on the engine by the generation. Thus the engine actually loads itself at constant speed regardless of variations in current required by the motors, caused by changes in car speed. This method of control is known as the Westinghouse UD-2 motor-operated face plate.

On the Mack power plants, all control equipment, except the master controller, is mounted on the power unit itself. The car control is effected from Westinghouse TC-105-A centralized control stations. This type of control combines all of the control equipment in the operating compartment.

In addition to the single-unit rail car which is at the Reading Terminal, one of the Pennsylvania cars is also equipped with Mack power plants as previously described.

Claude Burnham Dies

CLAUDE GEORGE BURNHAM, executive vice-president of the Chicago, Burlington & Quincy and the Colorado & Southern, died at his home at Kenilworth, Ill., on June 22, after an illness of five months. Mr. Burnham had been with the Burlington and the Colorado & Southern for 26 years and had been executive vice-president of those railroads since the year 1919.

Freight Car Condition

FREIGHT cars in need of repair on June 1 totaled 151,359 or 6.7 per cent of the number on line, according to reports just filed by the carriers with the Car Service Division of the American Railway Association. This was a decrease of 2,809 under the number reported on May 15, at which time there were 154,168 or 6.9 per cent.

Freight cars in need of heavy repairs on June 1 totaled 108,357 or 4.8 per cent, a decrease of 896 compared with May 15, while freight cars in need of light repairs totaled 43,002, or 1.9 per cent, a decrease of 1,913 compared with May 15.

Locomotives and Freight Cars Installed and on Order

CLASS I railroads in the first five months this year installed 700 locomotives, according to reports filed by the carriers with the Car Service Division of the American Railway Association. Compared with the corresponding period last year, this was a decrease of 82 in the number of locomotives installed. It was also a decrease of 233 compared with the corresponding period in 1926.

For the month of May alone, the railroads placed in service 139 locomotives, compared with 148 in May the year before.

Locomotives on order on June 1 this year totaled 113, compared with 291 on the same date last year.

Freight cars installed in service in the first five months in 1928 totaled 22,268, compared with 30,251 for the same period in 1927 and 42,300 for the same period in 1926. Freight cars installed in May this year totaled 6,633, compared with 8,185 in May, 1927.

The railroads on June 1 had 20,712 freight cars on order, compared with 23,949 on the same date last year and 44,628 on the same date in 1926.

These figures as to freight cars and locomotives include new and leased equipment.

Purchasing Agents Met Fifty Years Ago

IT is well known that there was an association of railway storekeepers prior to the birth of the Purchases and Stores Division and that by degrees the purchasing officers became participants in it, but it is not so well known that long before J. P. Murphy and a few others got the storekeepers' meetings started, over 50 years ago, in fact, there was a "really" purchasing agents' association. To prove it we offer excerpts from pages of the Railway Review (since absorbed by *Railway Age*) for the month of May, 1878, concerning a meeting held at the St. Nicholas Hotel, New York City.

"The annual convention of the Association of Railway Purchasing Agents at New York last week was an interesting and instructive meeting to all participating. The attendance was somewhat larger than heretofore and the members were faithful to the true object of their gathering—learning from the investigations and experiences of each other. * * * The proceedings consist of informal discussions in conversational style of the various topics in which all are interested. Each individual asks such questions as he desires more light on, and in turn imparts his own opinions and experiences. In this way, the most practical results are obtained. Single facts brought out are in many instances of more value than the whole expense and trouble of attending the convention. If general managers would look into this subject a little more closely, they would not merely permit but urge upon their purchasing agents to attend the conventions.

"There are two erroneous ideas current regarding this association. One is that its object is to discuss prices and the merits of the goods of this or that firm of manufacturers. Nothing of the kind is done. No general manager need fear that any advantage which his road has acquired in prices, etc., will be made public; and no manufacturer need hope for or fear a discussion of his specialty. The discussions are limited to qualities and methods. True economy in purchasing and using, is the point aimed at, and no one who has "sat through" the discussions, or read the printed proceedings, will doubt that the field is large enough. * * * *

"The opinion that there are getting to be too many associations and too many conventions in the railway service may be correct; but a close attendance upon the convention of last week has convinced us that this opinion cannot apply to the association of Railway Purchasing Agents. Indeed, we regard their meetings as invaluable to the roads they represent. In confirmation, we could, if necessary, show cases where many thousands of dollars have been saved to the roads concerned, as the practical results of this association."

Registration, American Railway Association

Division V—Mechanical

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Booth, C. W., M. M., N. Y. N. H. & H., Richmond
Bower, B. O., M. K. & T., Traymore
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McGueen, A. B., For. Car Dept., N. Y. C., Shelburne
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Sheedy, J. A., M. M., Penna.
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Snyder, F. M., Gen. For., Penna., Craig Hall
Spaide, Geo. S. W., For., Reading
Stagle, Calvin G., M. M., B. & O., Ambassador
Sugg, C. R., Elec. Eng., A. C. L., Traymore
Sulez, G. E., Ch. Draft., D. L. & W., Strand
Summer, Eliot, Asst. to S. M. P., P. R. R., Chalfonte
Sutherby, A., M. M., Erie, Marlborough
Sweeley, E. H., Gen. For. M. P., L. I., Haddon Hall
Switzer, W. G., Elec. Insp., N. Y. C.
Swope, B. M., S. M. P., P. R. R., Glaslyn Chatham
Tate, M. K., Mgr. of Service, Lima Loco. Works, Dennis
Tatum, J. J., Supt. Car Dept., B. & O., Marlborough
Taylor, C. P., Elec. Eng., N. & W., Ritz-Carlton
Thibaut, Geo., Asst. Mech. Supt., Erie, Strand
Todd, John, M. M., Erie, Strand
Townsend, Geo. R., Per. Dept., D. L. & W., Ritz-Carlton
Train, A. H., Spec. Eng., N. Y. C., Haddon Hall
Trexler, H. C., M. M., Sou., Craig Hall
Trout, H. E., V. P. & Gen. Supt., C. & B. L., Colton Manor
Troutman, G. A., Gen. For., H. & E. T., Louran
Turpin, Linwood, A. B. Insp., Reading
Tutt, T. I., Pres., P. T. L., Traymore
Unruh, Geo. E., Ch. Cl., S. M. P., N. Y. C.
Van Gundy, C. P., Eng. Tests, B. & O., Chalfonte
Vaughan, R. C., V. P., Can. Nat., Ritz-Carlton
Wadsworth, C. D., Asst. Gen. Mgr., Quebec Central, Strand
Walker, H. D., Asst. Eng., I. C., Traymore
Walsh, J. H., V. P. & G. M., Quebec Central, Strand
Ware, C. C., Elec., W. J. & S. S.
Warthen, H. J., S. M. P., R. F. & P., Marlborough
Watkins, Thomas, M. M., Reading
Wertman, John, Gen. Rdse. For., Penna.
Whalen, Milton W., For., B. & O., Arlington
Whitley, Geo., Asst. S. M. P., C. P. R., Ritz-Carlton
Whitsitt, W. B., Mech. Eng., B. & O., Shelburne
Wilcox, E. M., M. C. B., I. H. B., Princess
Williams, E. V., S. M. P., B. R. & P., Chalfonte
Williams, A. J., Ch. A. B. Insp., Penna.
Williams, Wolseley, R. F. E., Reading, Ambassador
Wilson, Peter M., Sec. to G. S. M. P., I. C., Ritz-Carlton
Winship, L. C., Elec Eng., B. & M., Eastborne
Wray, R. W., S. M. P, Penna., Haddon Hall
Wright, G. I., Eng. Elec. Trac., Reading
Wyle, Bruce, Asst. Elec. Supv., A. C., Knickerbocker
Yates, L. L., Gen. Supt. Car Dept., Pac. Fruit Exp., Traymore
Yorke, N. R., Ch. Mech. Insp., N. Y. N. H. & H., Penn Atlantic
Young, J., Jr., M. M., Penna., Strand
Yula, Ralph, Car Insp., A. C.
Zimowski, Frank, Supv. Eng. Ltg., N. Y. N. H. & H., Vermont Apts.

Division VI—Purchases and Stores

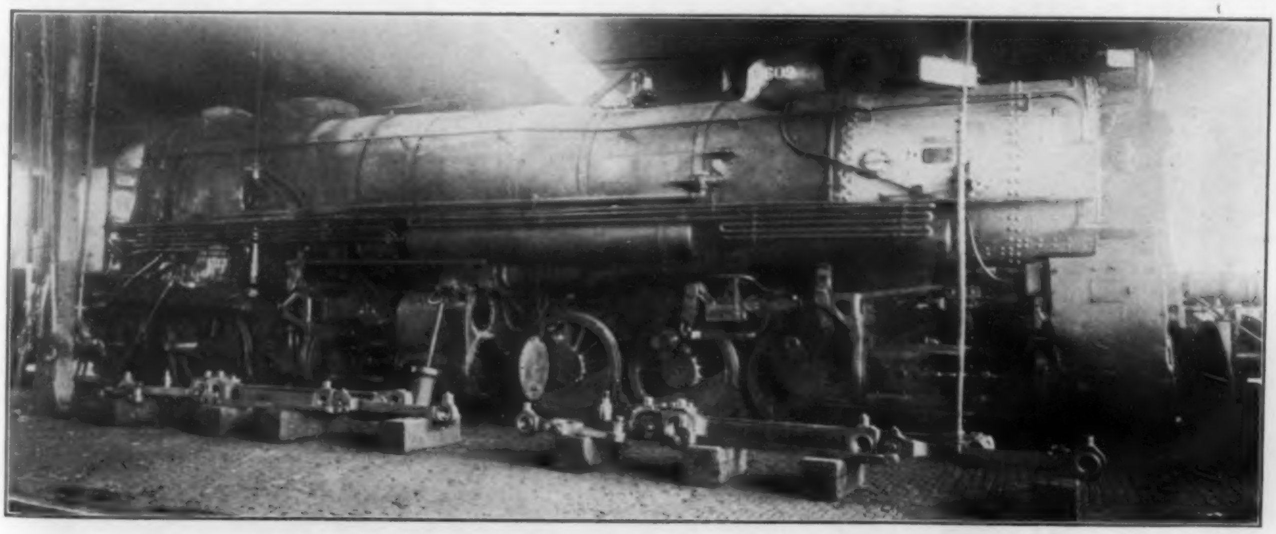
Beyer, L. B., Asst. Pur. Agt., Reading
Burr, H. S., Asst. Mgr. Stores, Erie, Strand.
Grammer, F. L., Asst. P. A., Penna., Chelsea
Lauman, Harry, Dist. Stk., B. & O.
Liversidge, R. M., Ch. Cl. to P. A., L. & N. E.
Longacre, Wm. E., Asst. For., Reading, Millers Cottage
Loos, Lliwelly, N. K., Gen. For. Stores Dept., Reading
McNichol, B. I., Stk., Reading
Mengel, William E., For. Gen. Stores Dept., Reading
Phillipe, B. P., Fuel, P. A., Penna., Ambassador
Portlock, Wm., P. A., S. A. L., Dennis
Rank, G. G., Asst. to P. A., Penna.
Schultz, C. H., Asst. Pur. Agt., P. R. R., Haddon Hall
Shadle, Henry H., Sub. Stk., Reading, Norwood
Skinner, L. H., Gen. P. A., Sou., Ritz-Carlton
Stackpole, W. S., Gen. Stk., Public Service, Haddon Hall

Motor Transport

Bacon, D. L., Supt. Auto. Equip., N. Y., N. H. & H.
Collier, L. S., Supt. of Motor Trucks, B. & O., Knickerbocker
Dell, G F., Insp. Motor Service, P. R. R.
Gower, J. A., Draft., Penna., Colton Manor
Fisher, J. B., Gen. Supt. Trans., Penna., Traymore
Hill, J. L., Supv. Agt. Motor Trans., L. I., Morton

Special Guests

Wm. S. Auman, For. Tool Room, Reading
L. R. Bates, Trav. Agt., B. & O.
John H. Becker, Insp. Loco., I. C. C.
Norman W. Bell, Draft. Eng. Dept., Reading
E. A. Bromley, Sec. to V. P., C. N., Private Car
M. C. Broughton, Dir. Ft. Agt., Penna.
E. P. Chase, Asst. Eng. Elec. Dept., Penna.
Leo Chelius, Asst. For., Reading, Lexington
J. H. Clark, Supt. Fltg. Equip., B. & O., Shelburne
B. D. Cougle, Mach. Shop For., L. V., Haddon Hall
W. C. Curren, G. M., B. & O., Chalfonte
H. S. Drumheller, C. C. to Gen. Supt., L. & N. E.
J. H. Gardner, V. P., N. Y., N. H. & H., Chalfonte
Harry C. Hanson, Loco. Insp., I. C. C.
Tiffin, Harris, Insp. Brd. of Ry. Comm., Canada, Chettnham Reveree
Frank, Hedley, Pres. & G. M., I. R. T., Ambassador
J. D. Jones, Supt. Tele. & Sig., Penna.
R. W. Keller, Elec. For., C. R. R. of N. J.
C. P. Klockars, Ch. Draft., C. R. R. of N. J.
Chars. R. Lenich, Asst. For., Reading, Newfield
Philemon S. Lewis, Supt. Reading
W. S. Logan, Ch. Clk., W. J. & S.
Eugene F. Lynch, Clerk Pur. Dept., Reading
Miller, J. R., C. C. to Supt. Shops, B. & O., Ambassador
Geo. J. Mobley, G. M., Delray Conn., Lafayette
J. G. Morgan, Dir. of Per., D. L. & W., Breakers
J. E. Muhlfeld, Cons. Engr., K. C. S., Shelburne
James H. North, C. C. to O. P. & G. M., L. & N. E.
E. J. Patterson, M. M., Phila. West Ches., Ritz-Carlton
O. R. Pendy, Spec. Appr., N. Y. C. & S. L.
A. J. Purinton, V. P., A. C. & S.
D. M. Sheaffer, Ch. of Pass. Trans., Penna.
Walter H. Smith, Asst. Eng. Eng. Dept., Reading



Main and Side Rods Assembled Ready for Application to Heavy Mallet Locomotive

Conventionalities

Charles B. Moore, Oxweld Railroad Service Company, will not attend the conventions this year. He is recovering from a severe illness.

One of Friday's convention visitors for the day only, was A. S. Henry. He started with the Railway Steel-Spring Company as a boy and, since the last convention, has been elected president of that company.

A. H. Armstrong of the General Electric Company, in referring to the decidedly British mien of the Baltimore & Ohio locomotive being shown at the track exhibit, with its concealed piping and poppet valves, says, "It positively speaks with an Oxford accent."

George Fogg advises us that his "salt water soap" experience mentioned in Friday's *Daily* happened several years ago, and that this year Harry Caswell, shop superintendent of the Wabash, was the one that duplicated the experience, much to his discomfiture.

Paul Weiler, district manager of the Franklin Railway Supply Company at New York, is unable to attend the conventions because he is in a hospital at Dunkirk, N. Y. He has been critically ill from blood poisoning, but is now on the road to recovery.

Walter S. Carr will be joined at the conventions next week by his son, Robert. The young man is a graduate of the University of Chicago and recently has been doing work in the valuation department of the Southern Pacific.

Among the convention visitors this week was H. R. Safford, Jr. Mr. Safford is a son of H. R. Safford, executive vice-president of the Gulf Coast Lines, and stopped here on his way to his home in Houston, Texas, from Lawrenceville, where he is a student.

W. H. Sauvage is attending the convention this year in an entirely new capacity. He is vice-president and chief engineer of the recently organized Royal Railway Supply Company, Inc. The president of the company is C. M. O'Boyle.

R. L. Skidmore, more familiarly known to his friends as "Skid," after a long service with A. O. Norton, Inc., is this year attending the convention as a traveling representative of the Falls Hollow Staybolt Company. He will continue to cover his old territory in the south and the west.

The keen interest in aviation and transportation by air on the part of the railways is evidenced by the air trip taken this week from Minneapolis by Carl R. Gray, president of the Union Pacific, and Ralph Budd, president of the Great Northern. Let it be known also that Colonel Lindbergh was the pilot of the plane carrying these important railway officers.

We have always known that there was much latent talent among the supply fraternity, but J. H. Ainsworth, of the Byers Company, has just disclosed the singing qualifications of Wm. Damberg, of that company. Damberg is anxious to enlist any of the visiting members who can sing Swedish songs in Swedish. All those of Swedish origin are asked to stop at the Byers booth and present their qualifications.

A. H. Williams, supervisor of apprentices for the Western Region of the Canadian National, is on the look-out for good tips as to successful methods or practices used in apprentice work. He expects, after the close of the convention, to visit two or three of the more important railroad apprentice schools in the east. Incidentally, Mr. Williams does not have to apologize for his own work, since he has had quite remarkable success in handling the apprentices in his region.

Retiring Chairman McKelligon, of the Purchases and Stores Division is prizing the unique momento that he received at the opening of the annual convention on Wednesday. His supply department friends presented him with a gavel made from five different woods from his native state, California. The gavel, which carries a silver plate appropriately engraved, will, of course, go back to California with the recipient, who will keep it as a treasured reminder of his service with Division VI.

Vice-chairman T. B. Wilson, of the Motor Transport Division, who hasn't had a vacation for three years, is wondering whether he ever will have another one. In addition to managing a rapidly growing system of motor coach lines and supervising the motor trucking contracts of the Southern Pacific, not to mention appearing at the innumerable hearings on his applications for motor coach operating certificates, he now has another job of considerable magnitude: the presidency of the American Association of Railroad Superintendents.

H. P. Hass, assistant to the mechanical manager of the New Haven, is attending the convention this year with Mrs. Hass. Mr. Hass reports that the new spring manufacturing shop being installed at the Readville shops is rapidly nearing completion. This shop will be equipped with modern electrical furnace control equipment and salt baths, and when completed will be used for the repair and manufacture of car and locomotive springs for the New Haven system.

One of the tallest, if not the tallest, visitor to the conventions, is William E. Elmer, Jr. He measures 6 ft. 5½ ins. and is a student at the Pennsylvania Nautical School. His dad would have liked to make a railroader of him, but on the other hand his grandfather was greatly disappointed when William, Sr., showed a preference for railroading instead of medicine. Incidentally, William, Sr., is now special engineer of the Pennsylvania System. He is also a manager of the American Society of Mechanical Engineers and has just been nominated for a vice-presidency.

Help—Assistance from old timers wanted! Fitz Sargent, of the American Brake Shoe & Foundry Company, has forgotten what he used to look like. Holding a record of having attended practically every convention for nearly 40 years, including such outlying meeting points as Old Point Comfort, Saratoga Springs and Thousand Islands, he now finds that upon looking at the group picture taken at one of the old gatherings at Saratoga Springs, he cannot identify himself although known to have been in the group. Any man who thinks he has an excellent memory for the past may render Mr. Sargent a real service in helping him identify himself.

Major G. E. V. Johnson, D.S.O., stores superintendent of the Central Argentine Railways, Ltd., is on a visit to the United States and Canada for the purpose of studying railway practice in those two countries. Major Johnson is in charge of the purchasing, stores and maintenance departments of the Central Argentine Railways, and is primarily interested in the detail practices of these three departments. He is also interested in the study of coal handling appliances, labor saving devices, and the methods used in handling grain. He expects to complete his tour shortly after the close of the conventions, and is planning to return to his home in Argentine by way of the Panama Canal.

Edward E. Gold of the Gold Car Heating & Lighting Company, is attending the convention this year in the capacity of chairman of the board, a newly created position. Mr. Gold has been the active head of the company and has attended all the conventions since the company was chartered in 1888. He has also been a member of the New York Railroad Club since its inception. Attending the convention with Mr. Gold are Frank W. Dearborn, who has been elected president of the company, and Franklin H. Smith, who has been elected assistant treasurer. Mr. Smith has been very active in the affairs of the R. S. M. A., and is now a member of the Executive Com-

It has been little realized that Chairman McKelligon, of the Purchases and Stores Division, labored under a heavy handicap in presiding over the long sessions of the division during the past three days. While enroute to the convention from San Francisco, he contracted a scalp irritation which has been diagnosed here as a case of "shingles." The malady, which is a nerve as well as a skin irritant, has spread considerably during the week and has left the retiring chairman, who is staying at the Chalfonte, exceedingly uncomfortable. It is possible that he may not return home immediately as planned, but may remain in this city or Philadelphia under a doctor's care until the trouble subsides.

Robert F. Carr, president of the Dearborn Chemical Company, was unable to stay through the conventions because he had to return to Chicago to make formal announcement of the engagement of his daughter, Louise, to William Press Hodgkins. The young people are to be married in January. Miss Louise was educated at Mrs. Walker's School at Simsbury, Conn., and at the French School for Girls at New York, from both of which she graduated. She was formally introduced to society by her father at his beautiful home in Lake Forest, last fall. Her prospective husband is a graduate of the Hill School and of Yale University. He is president of the Brownell Improvement Company, in which position he succeeded his father, following the latter's death about a year ago.

Several members of the American Railway Engineering Association have been discovered listening in on the meetings of the Mechanical and Purchases and Stores divisions, or looking over the exhibits on the pier. Among them are three members of the Water Service Committee of that association: R. C. Bardwell, superintendent water service, C. & O.; C. H. Koyl, engineer water service, C. M. St. P. & P., and A. B. Pierce, water engineer, Southern. Considerable attention is being given in the conventions to the large expenditures which are made for fuel and other materials and supplies. They are the food, but the presence of the water engineers is a reminder that locomotives must also have their drink and, as Mr. Bardwell is quick to point out, the volume and weight of this drink exceed the volume and weight of the food.

Regardless of statistics compiled by the medical profession, a railroad man's eyesight must improve with age. For example, during the Friday morning session of the Purchases and Stores Division, the chairman called on George G. Yeomans, a life member and who is well known to supply officers. Mr. Yeoman referred to a remark made by Mr. Waterman in his historical address on Wednesday to the effect that 15 or 20 years ago "men wore whiskers and women wore clothes." Mr. Yeoman claims that Mr. Waterman did not go back far enough and quoted the following verse to prove it:

Adam and Eve came down to Earth,
To see the styles that were made by Worth.
Says Eve to Adam, "Isn't it queer,
How little they've changed since we were here?"

Supervisory Force of the Delaware & Hudson Car Repair Shops, Oneonta, N. Y.

In the Texas & Pacific's New Storehouse at Fort Worth, Tex.

Purchases and Stores Division Closes Sessions

Vigorous discussions on practical subjects continue to close of last session—Elect Kyle and Davidson

THE third and last session of the ninth annual meeting of the Purchases and Stores Division came to a close yesterday after a record-breaking year for the animated discussions coming from the floor of the convention. The meeting was opened by the presentation of a committee report on handling maintenance of way stocks and by a continuation of the discussion of a report on delivering materials, both of which were carried over from the previous days' session. Following this, the division took up in order the regular scheduled program, including the presentation and discussion of reports on pricing materials, safety practices, method of purchasing equipment, and the manufacturing of material in railroad shops. The concluding event of the session was the election of officers, in which C. C. Kyle, purchasing agent, Northern Pacific, and Wm. Davidson, general storekeeper, Illinois Central, were elected chairman and vice-chairman, respectively.

Report of Committee on Control of Line Stocks

Customary stocks of rail for emergencies considered excessive——Stores should handle ties

E. H. Polk
Chairman

Line stocks are defined as all unapplied material not actually located in division or local stores or not in store department yards.

The control of line stocks starts with the original preparation of the requisitions by the using departments. Originators of requisitions for current needs should confine orders to minimum quantities dependent upon the period of time required to obtain the material. Requisitions other than those for current operating needs should specify the date material will be required.

The prompt shipment of material will go a long way toward reducing line stocks by creating confidence on the part of the using departments in the source of supply. The importance of assembling material at the storehouse and forwarding all items needed at one time or in the order in which the work will be done cannot be overemphasized. The stores department should continue control until the material has been actually used and if not promptly used as indicated by the requisition on which it was forwarded to the point of intended use, the failure to do so should be called to the attention of the officer in charge and if satisfactory results are not obtained from that officer, the case, if of sufficient importance, should be referred to the next officer in line and so on to the chief officer of the department.

For the proper control of line stock, a record should be kept of items forwarded with credits allowed as the material is actually used. For large jobs a separate record should be maintained. The record for the ordinary material may be maintained by sections or supervisors' districts.

One large railroad has successfully followed a plan, for a number of years, of having a line stock storekeeper or supervisor located on each division whose principal duties call for the maintenance of records of all material on the line and the frequent check of it.

The material supervisor or line storekeeper can transfer material to meet requirements or return material left over, released or not used. He is also able to assist the using department in properly storing and caring for material temporarily in its custody.

Maintenance of way requirements of spikes, bolts, tools, etc., should only be on hand in such quantities as to meet current needs and monthly supply train service is recommended as the

most economical method to be employed in supplying them.

The assembly and shipment of material to coincide with the arrival of gangs will permit uninterrupted progress of the work and at the same time prevent abuse and over-ordering. This plan is carried out on a number of roads.

New rail should be purchased on estimates furnished by the maintenance of way and construction department which are approved by the management for yearly requirements and contracts should be arranged as far as possible for delivery so as to fit in with the schedule for laying the rail to prevent reloading. Any change in the program after contracts have been made should be followed up by the store department and the rail stored by that department for use on the next program.

Relaying rail should be handled so far as practicable from the point released to the rail saw and then directly to point of use. Any quantity of relaying rail which cannot be so handled should be stored in rail yards under direction of the general or division storekeeper. Rail should be under control of store department until used.

Rail Racks Obsolete

The committee directs attention to the possibility of reducing rail stocks carried on rail racks to meet rail failures. Most roads have an established standard of one or more rails per mile of track. With the adoption of motor equipment for transporting replacements from section headquarters, requirements can be met with considerably less stock by keeping the rail only at section headquarters and replenishing this stock at regular intervals by supply train.

It is further recommended that not more than three rails should be maintained at section headquarters for the protection of a single track section of six miles. On new rail not more than one rail per section should be provided as the occasion for its use is usually rare during the first three or four years. The possible savings are large on all roads which maintain a standard rail rack distribution of one rail or more for each track mile.

Central Yard for Rail on Texas Lines of Southern Pacific

It is the general practice to purchase cross ties on estimates of a year's requirements as furnished by the maintenance of way department. It is recommended that control should be exercised by the purchasing and stores department over the delivery and distribution of these ties so that the stock can be kept at a minimum consistent with the requirements of seasoning, storage and treatment. The maintenance of way department estimates should show the quantities to be used during each month. Some roads successfully distribute ties by supply trains, unloading them at the actual point of requirements at the time of need.

At every car repair point where light repairs are made a man responsible to the store department should be stationed to control the stock. Material should not be scattered but should be kept in convenient locations properly cared for and in quantities sufficient only to meet current demands. Records should be maintained and checked at frequent intervals to insure a rapid turnover.

On larger construction jobs where labor and material are furnished by company forces, the committee recommends that the store department assign an experienced storekeeper who shall control all shipments of material to prevent over-supply, extravagance, and abuse, and prevent delays due to shortage.

It is recommended that so-called emergency stocks for the M. of W. department that have heretofore been held at other than store points be eliminated. It has been found that the store department can load and ship material needed in cases of emergency and have it at the point of use by the time men and equipment can be sent there to apply it.

Any method of control by the store department must necessarily have the full co-operation of using departments to be successful and the degree of co-operation can usually be measured by the service rendered by the store department.

The report is signed by E. H. Polk (chairman), district storekeeper, S. P.; L. C. Thomson, manager of stores, C. N.; G. W. Scott, district storekeeper, M-K-T; B. T. Adams, asst. general storekeeper, I. C.; C. A. Nichols, traveling storekeeper, N. P.; L. B. Wood, general storekeeper, S. P.-T. L.; A. L. Dumas, division storekeeper, C. & N. W.; G. W. Busch, division storekeeper, Wab.; W. B. Culver, general storekeeper, P. M.; E. G. Roberts, division storekeeper, C. R. I. & P.; D. H. Reed, traveling storekeeper, Sou.; J. S. Gabriel, storekeeper, D. & R. G. W.; J. W. Hagerty, general supervisor purchasing department, Penn.; A. J. Kroha, asst. general storekeeper, C. M. St. P. & P.; J. E. Mahaney (chairman ex-officio), supt. of stores, C. & O.

Discussion

D. B. Allan (U. P.): We will always have line stocks. The difficulty which confronts most of the railroads is the proper record in concise form of material carried for ordinary repairs in bridge and building, paint, fence, and, more particularly, in water service outfits. There is no difficulty in keeping records of material for so-called work-order jobs.

Mr. Polk: I want to direct attention to the fact that we say, "The committee recognizes there must be placed in the custody of the using departments located at other than store department points, a supply of material for their current needs and proper control," etc. That is the only stock we recognize should be in the hands of anyone else than the stores department.

Mr. Allan: It all depends on what you mean by current needs. In a large paint outfit you are not going to limit their stock to a matter of 30 days or 60 days. It is more liable to be 90 days. Are you going to keep proper records?

Mr. Polk: If you have a supply train operating on a 30 day schedule, why provide a 90-day stock of paint?

Mr. Allan: I would not undertake to say any large property would undertake to deliver paint if it does not know, when the train starts out, where the paint is going to be needed.

Mr. Polk: We do on our line. We get advance notice of where the users will meet the supply train on the line, and there is no necessity for the section, signal maintainers, or paint outfits to have any more material than what they are going to use, prior to the next delivery by the supply train or regular scheduled delivery.

B. T. Adams (I. C.): The railroads pride themselves on handling shipments promptly. They certainly wouldn't want it known that it would take 90 days to get a supply of paint to a paint gang a few miles from the storehouse. We can ship by freight, if not by supply train, in a few days to any point on the operating division and it never takes more than ten days.

Mr. Polk: The result of the committee's investigation has convinced us that there is too much material scattered over the line of property and a great portion of this material can be eliminated by proper control by the stores department.

Mr. Allan: To abolish stocks of rail on rail racks, and cut out entirely emergency stocks for wash-outs and fires, are two radical suggestions. I wonder how far a general storekeeper would get if he told his engineer of maintenance of way, "We are going to wipe out all these stocks of rail on your rail racks. We are going to move all this emergency bridge equipment. If you have a rail failure we are going to see that the rail is there. If you have a wash-out we are going to see the bridge material is there."

Mr. Polk: We have not said anything about wiping out any stock for emergency protection for bridges. What we do say, is that that stock must be at centrally located yards and under the jurisdiction of the stores department. It is scattered on many roads and it has been proven that the stores department can deliver that material in case of any disaster or any emergency faster than your maintenance of way department can get its crews there. We are not going to take the rails away. We are going to place them at the section toolhouses. They also have an emergency stock at toolhouses, where they pick up the rail and start out on a motor car.

J. G. Stuart (C. B. & Q.): I am glad to see the committee on Materials and Supplies recommend that line stocks be eliminated as far as possible. I do not like the idea of building storehouses and building yards and then getting material at almost any other place besides those places. The place for material is in the storehouse or the storeyard, not out along the line. It may be true that there are little things needed along the line. When work crews start for a bridge they usually start from a division point and it takes less time to get the material there than the men. Even when they get the men there, there is a lot of work to be done before they start using the material. I am for having the material where it belongs, where the stores department can always put its hands on it and not have to run out 6, or 8, or 38 miles where some other man thinks he has to have material so it will be convenient if he ever needs it.

L. F. Duvall (A. C. L.): I agree with Mr. Stuart and the committee. It is time we were getting down to cold facts on line stocks. Mr. Allan spoke of the material being in our account. If we have control over this material we are going to say how much and where it is carried, and that is what the committee is saying.

O. A. Donagan (B. & M.): We have been consolidating our maintenance of way stocks at our main store house. This question of special or emergency stocks has received a lot of attention. Our maintenance departments at first figured that they must have emergency stocks. We claimed that they did not need them. Particular emphasis was laid on the matter of lumber. "Suppose something happens during the night," they said, "and we don't have lumber at some of our contingent points?" We simply called their attention to the flood on the Boston & Maine last fall, and asked if they got service then? They replied, they certainly did. We then informed them the same condition existed as regards the stores department now that existed then and they are getting no emergency lumber stocks on the lines.

Mr. Allan: I would like to ask Mr. Stuart where he carries the spares for coal chutes. Does he carry them in his general storehouse?

Mr. Stuart: Spares are generally in the storehouse, and they are marked with the name of the item. A gearwheel may fit a half dozen coal chutes, and every coal chute that that gear can be used in is shown on the tag.

Mr. Allan: At an outlying coal chute that is from 150 or 200 miles from the store house, do you depend on that store house for a replacement?

Mr. Stuart: Yes.

(It was moved and seconded to accept the report. Motion carried.)

A Dollar Carefully Expended for Supplies

Railroads pioneers in development of laboratories to test materials——First rail specification in 1876

By W. W. Morris
Assistant General Purchasing Agent, Pennsylvania

How do we know what to buy? It is not quantity which disturbs, but the quality, the worth and the value. How is the true and the worthwhile to be separated from the falsely described and the shoddy? How may certain things be divested of all the glittering surroundings, so they may be seen just as they are, and so recognized?

Broadly viewed, the seller is putting forth greater efforts than the purchaser. Consumers, at large, appear to buy without much question. Articles are selected because of fancy, or because the examination, if it is made at all, is superficial or is not supported by real knowledge or the proper facts.

In contrast with this, however, the statement can be made that the railroads buy, and that the sellers do not sell. Organized offices in the railroad for the purpose of buying supplies and material go back as far as 1866. In that time, much knowledge has been accumulated.

The railroad purchasing organization also has had throughout a generation, at least, helpful aid in the laboratory, which undertakes investigations, testing, inspection and the writing of specifications.

Testing Laboratories Maintained

The Pennsylvania started the physical testing of materials in 1874, using its own apparatus. About one year later, in 1875,

Atlantic Photo Service

Railway Purchases and Stores Officers at Annual Meeting

a chemical laboratory was added to increase the scope of investigation. This little nucleus finally obtained a small building in 1879 and the growth has been rapid since then.

Research was first begun that steel rails might be improved, and a specification for steel rail was written in 1876. Today all railroads rely upon specifications for steel rails. From that beginning in 1876 sprung the preparation of specifications by railroads for essential materials. Records show that in 1881 specifications were written by railroads for tires; in 1882 for steel for locomotive boilers, fire boxes, and iron for staybolts; in 1883 for car and locomotive axles and for forging iron. The specifications of today number from 175 or 200, covering a variety of materials. These laboratory and inspection forces not only employ themselves in seeing that the requirements of specifications are met, but articles or compounds known and sold by a name, are examined and their contents divulged to the buyer, who is put in full possession of the facts. Adulteration cannot prevail before the chemist. The high priced article offered may be found to be a combination of ingredients which can be bought and combined to make a compound which will serve the end desired at much lower cost.

The wearing qualities of articles are determined by accelerated life tests in laboratories. At the St. Louis Exposition in 1904, a machine for testing locomotives was displayed. That plant has been in constant use on the Pennsylvania since then to gather data of all kinds relating to locomotives, and the fuel they use. There is also a plant at Purdue University, and another at the University of Illinois, where many tests are made for railroads and for the American Railway Association.

Railroads a Stimulus to Research

In a paper presented at the first Pan-American Conference on Uniformity of Specifications, at Lima, Peru, December 31, 1924, C. L. Warwick, secretary of the American Society for Testing Materials, said: "With the increasing diversity of materials and the increasing severity of requirements in service, there arose the urgent need for studying the properties of the materials and their performance under varying conditions of service. When we consider these properties, we are impressed with the fact that not much was known concerning them, in any exact sense, prior to the nineteenth century. Craftmanship—that is to say art, and not science, had been the basis of the use of materials in construction for centuries. Experimental data were few and imperfect. In the first fifty years of the last century, coincident with notable advances in pure and applied science, much progress was made in the theory and the knowledge of behavior of materials under stress. Railroad development served as a powerful stimulus in the investigation of materials because of the need for ample security with the greatest economy."

In 1901, the United States Government provided for the Bureau of Standards, under the Secretary of Commerce and Labor. The bureau was to establish the official standards of weights and measures. The Federal Government gradually called upon the Bureau of Standards for help in preparing specifications and in undertaking investigations and experiments, so that it has now grown to a great institution.

Wonderful laboratories and experimental and research facilities are an important part of the electrical industry, and of the automotive manufacturers. There are eminent technical societies and associations which have bureaus of investigation. But the railroads were among the pioneer investigators. They have not been merely followers. To get what it buys, and to buy only that which should be bought, is an axiom of the railroad purchasing agent.

Storekeepers Discuss Delivery of Material

Further light thrown on economics of paved roadways and supply train operation

[The following excerpts are taken from the discussion of a report which was published on page 160 of the June 22 Daily Edition of *Railway Age*.—Editor.]

G. A. Goerner (C. B. & Q.): In connection with a report on building and facilities (page 145, June 22 Daily Edition, *Railway Age*), the cost of concrete roadways was discussed. I believe that discussion should have come at this point. I stated the cost of building concrete roadways was about $1.20 a sq. yd. Mr. Morehead (I. C.) said it would come nearer to $4.20, and could not be put in for $1.20. I don't know of anything we might do to discourage concrete roadways more than to suggest that they are going to cost these exorbitant sums.

There may, perhaps, be some remote places where you want a roadway 10 or 12 in. thick, where it will cost that much, but for the ordinary roundhouse light repair tracks, and places of that nature, roadways 5 or 6 in. thick, if put on a solid foundation, and a proper mixture is used, ought not to cost much over $1 a sq. yd. We have put in some very good concrete roadways on the Burlington for $1.12 and $1.20 a sq. yd.

J. T. Kelly (C. M. St. P. & P.): I should like to ask Mr. Goerner what they use for reinforcing those roads to bring the cost down to $1.20. Don't you use any reinforcements?

Mr. Goerner: No. And the roads stand up. I am talking now of the average roadway, not of the main drives.

Mr. Kelly: You have to go over your average roadway with trucks and small wagons with steel and iron wheels, don't you? And they don't break up?

Group Picture Taken After Close of Session on Thursday

Mr. Goerner: No.

Mr. Kelly: We haven't as yet put in any concrete roadways. We are starting this week at our main shop and the engineers estimated, if I remember the figures, that it would cost about $2.35 per sq. yd. for a 7-in. road. They will be reinforced and we are going to use scrap iron for that purpose.

Mr. Goerner: The Union Pacific put in some 12-in. road at $2.95. That is a mighty thick roadway.

W. S. Morehead (I. C.): I said the $4.20 cost would cover the construction of roadways where there was grading to be done in old plants. Mr. Goerner is in the Chicago territory. If there is a contractor in that territory who will build concrete for $1.20, I'd like to have his name. The concrete portion of our roads is about $2.85, but we build these roads figuring they will get heavier service than any five-ton automobile truck will give them. You want your heavier roads where you are going to use 12-in. wheel trailers with five-ton loads.

C. H. Kelly (L. V.): A year ago we started concreting to quite a large extent. Our engineering department figured about 30 cents per sq. ft. That considered the excavating, and preparing and putting in the side forms, mixing the concrete, and finishing. The work consisted of a six-in. standard concrete mix for the use of our delivery tractors and trailors and our heavy trucks.

J. L. Irish (O. W. R. & N.): In front of a roadway in one of the docks at Seattle where the gravel and the sand was hauled not to exceed 30 miles over this railroad's own line, it cost 50 cents a yard for the sand and gravel and the cost of putting in the concrete, which was 6½ in. thick for city trucking, was $1.80 a sq. yd.. I do not believe you would find any better conditions under which to build the concrete. You can get some interesting data from the Great Northern. They installed concrete roads last year and are installing more this year. In Hillyard, Wash., they built a six-in. concrete roadway. Their only trouble arose in going over rails, with trailors having cast iron wheels.

A. L. Sorensen (Erie): Does the committee have any figures indicating the cost of using a gasoline crane in worktrain service for picking up scrap, etc.?

Mr. Irish: Some figures were received after the report on that subject was submitted. The number of worktrain days saved in the example given was 37, resulting in the saving of $3,310. The savings effected by loading scrap at terminals was $2,960. The saving through discontinuing the practice of carrying laborers with the supply train was $1,290; that for loading scrap at sections, of which $241 would have been overtime was $2,540. The saving in labor that would have been consumed in placing this scrap in sacks, etc., for hand loading was $1,360. The saving through shorter supply train days was $660. The saving from the necessity of moving cars from point to point to pick up scrap was $1,740. During this period the expense of operating crane and the salary of operator was $1,200, and gasoline used cost $180. The period was from August, 1927, to March, 1928, inclusive. The crane was placed in service August 1, 1927.

Report of Committee on Manufacturing Material

Survey discloses variation in practices——Supplies made in railroad shops listed

W. L. Hunker
Chairman

A questionnaire was sent to the railroads asking them to furnish replies to six questions. These questions and the replies are given as follows:

Question 1.—A list of material manufactured.

A list was compiled from the replies received from 41 railroads. This list shows that roads operating in the same territory are far apart in their practices. The committee believes it would be beneficial for each railroad to make a survey of its requirements and determine which practice (purchase or manufacture) is best, bearing in mind the available sources, plant requirements, overhead charges, etc., and not forgetting that in manufacturing materials, two stocks are involved, raw and finished, with the attendant handling and carrying charges; also that finished materials received from the manufacturer are ready to put on the shelves, or in cases that can be easily handled. As an illustration, small bolts from manufacturers are received in standard size packages, while those manufactured in the railroad company's plants are usually in bulk and require a great deal more labor in handling and shipping.

Question 2—What method is used to determine the most economical quantity of material to manufacture?

The replies indicate that the quantities, if in excess of a normal supply, are determined through conferences between stores and shop forces, and shown as ordering units in the stock books. At times, it is more economical to increase the non-productive labor cost, than it is to manufacture material in excess of reasonable quantities. All factors should be taken into consideration and the best interests of the railroad, rather than any department, should govern. It would be money wasted to manufacture a large quantity of any item to overcome non-productive labor, if there were no reasonable outlet for the items thus manufactured.

Question 3.—What method is used to determine whether it is cheaper to manufacture than to purchase?

The replies indicate the usual practice to be that of checking the shop costs from time to time, and to purchase or manufacture according to these costs. Some roads with separate manufacturing facilities secure bids from their shops as well as from manufacturers, and govern themselves by the results. The replies indicate a quickened interest in this question.

Question 4.—Have any changes been made in recent years favoring manufacturing to purchasing, or vice versa?

The replies show that several roads are making an intensive study at this time, but results have not been released. One road is not making any additions to present facilities, expecting to purchase a great deal more material in the future. One road is concentrating its manufacturing at one shop, and expects tc extend the items manufactured. Other roads have added some items to their own manufacturing plant and dropped others. A few are now purchasing more and manufacturing less, while on several there has been no decided change either way. In general, the facilities available, and local market conditions, governed the changes made.

Question 5.—What method is used to follow shop orders, to see that delivery is made as quickly as purchased material could be delivered?

In general, shop orders are hurried the same as purchase orders. In some cases, lists are furnished the mechanical department of shop orders over 30 or 60 days old at the first of the month, and these orders are given preferred attention. The majority of replies indicate that shop manufactured material is delivered in about the same length of time as purchased material.

Question 6.—What kind of a check is made to ascertain whether costs on shop orders are reasonably correct?

The replies show that shop order costs are compared with previous orders and the purchase costs of the same kind of material, and errors in labor or material charges are adjusted.

The committee studied the question of repair parts for various devices, the cost of which appeared to be excessive. This has been found true in some instances, and the material has been manufactured by the railroad. In some cases the manufacturer has reduced his costs to retain the business. This problem requires attention at all times, especially now that so many new items are being added to equipment. Each item should receive careful analysis as to the purpose, kind of material, etc. On some items made of special alloy materials, it is better to pay high price, than to attempt to manufacture something that might

look the same, but which would require more frequent renewals and cause a failure or delay, costing several times the savings in the cost making the item.

Material Manufactured in Railroad Shops

Class 1-A

Material	No. Roads	Material	No. Roads
Blocking, frog	5	Plates, guard rail	3
Blocking, guard rail	3	Plates, slide	4
Bolts, frog and switch	6	Plates, sw. point	2
Braces, slide plate	1	Point, switch	6
Castings, frog and switch	11	Rails, guard	9
Clamps, guard rail	1	Rods, connecting	2
Clips, transit	1	Rods, head	2
Frogs	7	Rods, tie	2
Plates, frog	2	Stands, switch	2
Plates, gage	2		

Class 1-B

Bars, offset	1	Shims, wood track	1
Plates, tie	1		

Class 1-C

Bars, claw	2	Gages, track	8
Bars, lining	3	Guards, cattle	3
Bars, pinch	5	Hinges, gate and parts	7
Bars, tamping	3	Levels, track	8
Bars, timber	4	Pickaroons	1
Bits, track drill flat	2	Picks, clay	1
Boards, spot	13	Plugs, tie	4
Bolts, anchor	12	Pullers, spikes	1
Boxes, dump	6	Punches, track	2
Boxes, section tool	8	Shims, rail laying expansion	7
Chisels, track	3	Tons, rail	5
Frames, grindstone	1	Tongs, tie	3
Forks, rail	2	Wrenches, track	1
Gate, farm	2		

Class 1-D

Boxes, motor car	5	Hand car parts	3
Cars, hand	3	Motor car parts	2
Cars, push	5	Push car parts	3
Covers, motor car	8	Velocipede parts	2

Class 2-A

Blades, signal	4	Insulators, fibre	2
Boxes, battery	2	Joints, Weber parts	3
Boxes, relay	2	Posts, signal	3
Capping	4	Relays	3
Carriers, pipe	4	Trunking	4
Chutes, battery	3	Wells, battery	1

Class 2-B

Arms, cross	2	Bolts, cross arm	1
Boxes, shelter	1		

Class 3

Barrels, water—concrete	2	Shingles, tin	1
Blocks, concrete	1	Slabs, bridge	4
Jacks, smoke (roundhouse)	1	Tin, valley	1
Pipe, concrete	4	Troughs, hog	2
Posts, concrete R. of W. fence	3	Troughs, water	1

Class 4-B

Posts, fence (from old flues)	3	Stakes, engrs.	8
Signs, roadway	21		

Class 11

Bolts, button head	9	Bolts, radial stay	13
Bolts, carriage	10	Bolts, rod keeper	15
Bolts, cellar	21	Bolts, side rod collar	9
Bolts, countersunk head	13	Bolts, stay	21
Bolts, crown bar	13	Bolts, tie head	16
Bolts, ecc. crank collar	13	Bolts, wedge	21
Bolts, flexible	9	Bushings, staybolt	10
Bolts, grate bar	13	Nuts, castle—small	3
Bolts, guide	11	Nuts, castle—large	6
Bolts, hand hole plate	10	Nuts, crank pin	11
Bolts, hex hd. engine	28	Nuts, knuckle pin	9
Bolts, hook	12	Nuts, piston rod	8
Bolts, jacket lug	14	Nuts, square	3
Bolts, key	18	Rivets	8
Bolts, machine, ½" and under	8	Studs, standard	25
Bolts, machine, ⅝" and over	21	Studs, boiler	25
Bolts, patch	14	Washers, from scrap	7

Class 12

Clips, spring	4	Springs, elliptical	13
Springs, coil—small	14		

Class 13-A

Bands, superheater	2	Rings, superheater unit	2
Bolts, superheater	5	Shields, superheater	2
Cylinders, superheater damper	2	Supports, superheater tube	2
Ends, superheater unit	2	Units, superheater	2
Gaskets, superheater	2	Washers, superheater	3

Class 14

Babbitt	6	Spelter	2
Ferrules, copper	3	Solder	7
Lead, for wheel centers	2		

Class 15

Billets	1	Shims, tire	6
Iron, bar	3	Steel, mild	2
Shims, flue	9		

Class 17

Bars, draw loco. and tender	9	Links, Union	2
Bars, transmission	1	Pins, brake hanger	20
Beams, loco. brake	5	Pins, crank	7
Bushings, washout	5	Pins, draw bar	14
Casings, cyl. head	8	Pins, knuckle	14
Casings, piston valve	8	Pins, wrist	12
Chain, loco. safety	10	Rods, loco. driving	10
Forgings, loco. (part or all)	35	Rods, piston	5
Gibbs, sprg. hanger	4	Rods, reach	3
Guides, crosshead	4	Stems, valve	5
Hangers, spring	7	Straps, rod	4
Heads, rolled steel piston	1	Washers, crank pin	15
Keys, crosshead	7	Wrenches, grease cup	3
Keys, knuckle pin	5	Yokes, valve	3

Class 18

Aprons, ballast car	1	Forgings, car—all	20
Planks, spring	4	Forgings, car—part	21

CLASS 19

Castings, grey iron	11	Rings, by-pass	1
Castings, steel	2	Rings, cylinder packing	15
Cocks, cylinder	5	Rings, valve packing	14
Plugs, grease cup	5		

Class 20

Beams, brake	1	Castings, grey iron	12
Bushings, D coupler	1	Castings, steel	2
Shoes, brake	1		

Class 21

Bearings, journal	15	Hammers, copper	5
Castings, brass	15	Plugs, washout	6

Class 22

Air brake mat'l repair parts	4	Gaskets, feed valve	2
Cocks, air	1	Rings, piston	1
Cocks, drain	1	Swabs, air pump	1

Class 23-A

Checks, boiler parts	3	Plates, grease cellar end	2
Cocks, cylinder	3	Plates, grease cellar perforated	2
Cocks, gage	3	Regulator parts	2
Cups, guide	4	Ringers, bell parts	2
Gauges, water	2	Sander parts	2
Guards, tank hose	1	Strainers, tank hose	10
Guards, water glass	2	Swabs, piston valve	2
Handles, gage cock	2	Swabs, valve stem	2
Injector parts	3	Valves, blow-off parts	2
Lubricator parts	6	Valves, pop parts	3
Packing parts	5	Valves, relief	2
Packing piston rod	6	Valves, throttle parts	2
Packing valve stem	6	Whistles and parts	6

Class 23-B

Booster parts	2	Heater, feed water parts	1
Boxes, train control	3	Openers, door parts	2
Column water parts	2	Stoker parts	1
Gear, reverse parts	2	Train control parts	2

Class 24

Bags, canvas	3	Sheets	2
Boxes, stepping	11	Springs, mail rack	1
Brackets, mail rack	1	Steps, coach	8
Covers, head rest	6	Towels, hand	2
Covers, pillow	2	Towels, roller	2
Curtains, vestibule	5	Trimmings, coach (part)	3
Curtains, window (coach)	3		

Class 25-B

Cases, headlight	3	Headlight parts	2
Coils, feed	3		

Class 25-C

Connectors, trainlight	1

Class 29

Cleats, cotton	2

Class 32

Boxes, fire	12	Cabs, wood	12
Pilots	12	Fronts, smoke box	2
Cabs, steel	12		

Class 36-A

Awnings, loco. cab	6	Hooks, cotton	1
Bars, eng. pinch	8	Hooks, packing	15
Bars, slash	12	Hooks, rfgr. car	2
Bars, station	13	Hooks, ice	1
Barrels, fire	6	Jacks, journal	1
Blocking, auto	3	Kegs, water	3
Blocking, explosive	5	Knives, packing	15
Blocks, jack	3	Ladders, straight	4
Boards, station bulletin	7	Ladders, step—coach	7
Boxes, engine cab	12	Levers, jack	12
Boxes, engine water cooler	10	Pans, ice	2
Boxes, first aid	2	Picks, coal	4
Boxes, portable tool	11	Picks, ice	2
Boxes, trainmen	10	Poker, stove	9
Boxes, waybill	3	Poles, pike	3
Cables, switch	3	Poles, cotton	2
Carts, mail	2	Poles, push	8
Cases, cab form	8	Pumps, sta. barrel	1
Cases, fire extinguisher	1	Recharges, fire ext.	2
Cases, flag	13	Rests, cab arm	17
Cases, fusee	13	Scrapers, ash pan	1

Cases, tariff	4	Screens, acme lamp wick	1
Cases, torpedo	5	Seats, engine	4
Cases, water cooler	1	Shades, eng. gage lamp	5
Chains, train	7	Shields, cab window	3
Cleaners, window	2	Shields, eng. gage lamp	1
Coolers, hot box	3	Shields, stove	1
Coolers, water	12	Shovels, fire	3
Covers, water barrel	4	Skids, freight	10
Curtains, cab	23	Stands, typewriter	2
Curtains, window	5	Sticks, ventilator	3
Cushions, caboose and eng.	17	Sticks, wheel	7
Cushions, chair	5	Stoppers, flue	1
Desks, caboose	7	Stoves, ash pan	5
Desks, wall	5	Stove parts	4
Dollies, timber	4	Stove pipe	12
Flags	6	Stove smoke jacks	14
Guards, dust	9	Stretchers	7
Handles, car mover	1	Tables, telegraph	4
Handles, brakemen	1	Tinware, part	17
Handles, flag	18	Tongs, ice	1
Handles, window brush	4	Trays, stock	18
Hoes, ash	14	Trucks, baggage	5
Holders, bin label	4	Trucks, warehouse	5
Hooks, clinker	12		

Class 36-B

Doors, grain	1

Class 37-B

Bungs, barrel	1

Class 42

Fittings, pipe—part	8

Class 45-A

Bars, jack	1	Keys, flat split	4
Cotters	1	Screws, set	1

Class 45-B

Augers, ship, bridge	5	Hammers, boiler makers	3
Bars, chisel	2	Irons, soldering	4
Bits, square drill	2	Mallets	4
Blanks, air hammer chisel	6	Punches	5
Busters, rivet	2	Rollers, flue	4
Chisels, caps	6	Shields, welder's	3
Chisels, cold	10	Sledges	2
Chisels, rivet buster	5	Snaps, rivet	2
Chisels, special	6	Swedges, blacksmith	3
Drills, stone	3	Tongs, rivet	2
Drivers, screw	2	Tools, beading	8
Expanders, flue	2	Tools, calking	2
Flatters	3	Wrenches, S	5
Gages, wood	2	Wrenches, Spanner	5
Hammers, ball pin	4		

Class 46

Gaskets, copper	2	Gaskets, rubber	2
Gaskets, lead	3		

Class 47

Compound, boiler	2	Paint	2
Compound, grinding	3	Paint, part	2

Class 48

Clipboards	1

The report is signed by W. L. Hunker (chairman), district storekeeper, C. R. I. & P.; E. R. Brinton, asst. general storekeeper, C. & O.; J. T. Kelly, general storekeeper, C. M. St. P. & P.; W. S. Riach, chief clerk to general storekeeper, A. T. & S. F.; V. Elliott, traveling storekeeper, N. & W.; H. M. Dewart, purchasing agent, C. V.; O. V. Daniels, general storekeeper, Penna.; H. B. Akin, district storekeeper, C. N.; J. W. Cockrill, division storekeeper, I C.; H. F. Burnett, general foreman, K. C. S.; H. C. Stevens (chairman ex-officio), general storekeeper, Wab.

Discussion

B. T. Adams (I. C.): In determining whether an article should be manufactured in the shops or purchased, the main thing is quality. We buy material on specification. We have rigid tests and inspections made of the material. But we do not always have such rigid requirements with regard to the materials we manufacture in our own shops. I have frequently seen items made in our shops that we would not accept from a manufacturer, yet those items are taken and placed in stock, where they remain indefinitely. So the important thing is to be sure that you get the same quality, the same degree of perfection in your own shops that you require from a manufacturer giving you the same items.

Mr. Hunker: There should be as much attention given to inspection of shop manufactured material as there is to purchased material. Our stock man, if the shops attempt to turn over to him something that is not exactly as it should be, puts it to one side. The inspector looks it over and in case there is any difficulty we call the shop superintendent, and in a good many cases the material goes back to the shop to be fixed up so that it can be used.

T. J. Hegeman (C. B. & Q.): We have a shop manufacturing plant, in which we manufacture material for the system in quantities, to get a production output. In connection with this, we have a cost department to analyze the cost on every article manufactured. In that cost, we set up an overhead that is not based on the overhead established by the Interstate Commerce Commission, but we take the actual overhead which amounts to something like 60 or 70 per cent, as compared with the 30 or 35 per cent that is usually used. Our engineer of tests examines and tests the material before it is delivered to the store house and he requires the same quality and appearance that he would from a manufacturer. In fact, I think sometimes he gives it a more rigid test.

J. G. Kirk (C. R. I. & P.): Estimating overhead is something that ought to receive serious consideration. Most of us, of course, do it in accordance with the I. C. C. method of accounting, and we all know that under that method such items as depreciation, repairs to the buildings, repairs to the tracks, accidents to employees, and things of that kind do not get into the overhead. When an item is made in the shop, the ordinary shop overhead billed to us, is around 40 per cent. A manufacturer generally adds from 100 to 125 per cent. We know that. So when we make comparisons, we ought to take that into consideration. But if we can make a thing for $2 that costs us $5 to buy, we certainly oughtn't to buy it.

C. D. Young (Penna.): It seems to me the committee has overlooked a very important feature of the subject, and that is the storekeeping end of manufacturing materials. Its approach to this problem has been largely as a means of determining whether or not it is the correct thing to manufacture or to buy, whereas I think the bigger problem is to determine whether you should manufacture the article or whether you should be able to transfer some surplus stock from some other store house to the shop that wants to manufacture, and thus avoid manufacturing it at the point needing the material. There we bring into play the store question in connection with shop-order material.

On some of the larger roads, four or five of the main shops may be manufacturing the same items, particularly for repairs to equipment. You may have a slow-moving stock or a surplus at one shop, and another shop will be issuing a shop order for manufacture of the same item, and you are pyramiding your store stock, your total stock, by not liquidating.

We found that was true on our road, and in order to overcome it, we found it necessary to have a general storekeeper of manufactured material. He issues all the shop orders issued for all the shops on the whole railroad. But before issuing those shop orders, he surveys his stock of those manufactured items to determine, first, whether he has a surplus or slow-moving stock at other points; if so, he liquidates that, and arranges for the raw materials from which to manufacture.

The committee, if it is continued, and I think it should be, should study the system of stores in connection with manufacture and give careful attention to that subject, as well as to the question of whether or not it is cheaper to manufacture your own materials or whether it is cheaper to buy them. There is a great deal that can be done in the way of reducing inventories by getting hold of the manufacturing shop orders.

D. C. Curtis (C. M. St. P. & P.): What Mr. Young says is very important. I have also been impressed with the fact that we can manufacture sometimes in the shop cheaper than we can purchase. I am wondering if,

where items can be manufactured for $2 that cost $5 when purchased from outside manufacturers, that fact has been brought home to the purchasing agent, and if they are co-ordinating their costs in the shop with the purchasing agent to see if he cannot get an equal cost price from the manufacturer.

The manufacturers of this country today are manufacturing more than is demanded, and they are anxious to get everything under their control that they can, and they are open to suggestions from the purchasing agent as to reductions in price. Unless these storekeepers give these figures to their purchasing agents and keep them advised on these things, they are not going to be able to get the reductions in price that they should get.

A. L. Sorenson (Erie): I would recommend that the committee, if it is continued for the next year, consider making some comparisons with shops that are entirely on a manufacturing basis, as to getting what might be considered a reasonable and proper overhead, and compare that with the overhead that is being added to shop orders, for the purpose only of comparing with the open market prices.

(It was moved and seconded that the report be approved. Motion carried.)

Report on the Unit Pricing of Materials

Committee favors labelling all supplies with unit cost——— Would scrap price books

E. D. Toye
Chairman

It is recommended that the pricing of material in the charge of the stores department be performed by stores department employees, such as stockkeepers and their assistants, who are responsible for the ordering and issuing of such material, and that this be done in the immediate vicinity of the material.

It provides more accurate pricing, because it is the most direct method practicable.

It overcomes the difficulty resulting from material orders or requisitions being illegibly written and improperly or incompletely described.

It accelerates pricing of issues.

As the result of more accurate pricing, inventory adjustments are appreciably reduced.

It familiarizes the employee responsible for the ordering of material with its value.

It is a means of familiarizing using departments with the value of material.

Railroads now following the recommendation state that this system of pricing will effect a payroll saving.

It is a deterrent to the prevalent practice of pricing from memory, which contributes to incorrect pricing.

It tends toward more accurate distribution of the material classification.

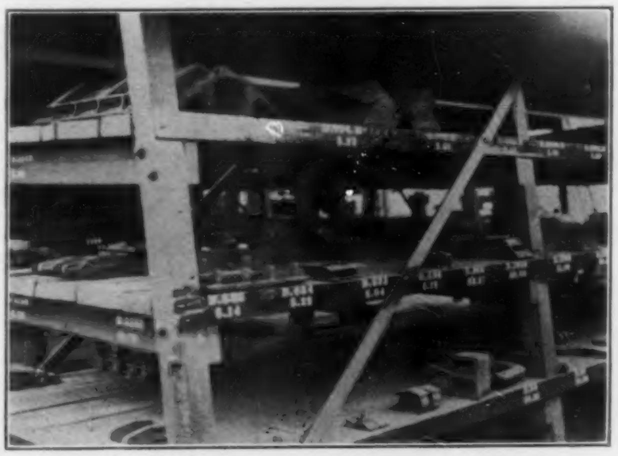
It encourages stockkeepers to check the price of stock which is not bought on a competitive basis, which guards against flagrant overcharges.

Locomotive Tires Stenciled with Unit Prices

The following methods are reported by railroads which have already adopted the recommendation of this committee:

Price Tags Used on Road A

The pricing of issues on Road A is performed in the store by section stockmen and their helpers. The actual cost price is applied to each item of material immediately on receipt. On the larger items, the price and units are stenciled on the material. On the smaller items, a small price tag is attached to one or more of the articles. The price is obtained, in the case of direct shipments from manufacturer, from the copy of the purchase order, this information being shown on the section stockkeeper's copy by the purchasing agent's office at the time order is placed. Transportation charges, if any, are added on the arrival of the material. This work is performed daily by the section stockkeeper and helpers. No material is placed in stock without a price being applied. No other price record is maintained. Bin cards or labels are not used, nor is the price shown in the stock book. In case information regarding prices is required for statistical purposes, this information is obtained from the office copy



Material Rack Stenciled with Unit Prices

of purchasing order. A considerable reduction was made in payroll when this system of pricing was put into effect. Inventory adjustments have been reduced and inventories have been produced much quicker. This system of pricing goes further towards spreading information amongst the rank and file of employees as to the value of material than any other method which has come to the attention of this road.

Bin Labels Favored on Road B

The pricing on Road B is performed in the storeroom by the section stockkeepers and helpers at the time material is issued. The price is shown on a bin label fastened to the shelf directly under the material. This price record is maintained by sending a copy of the invoice to the stockman in charge of the material. In the case of direct shipments a copy of the merchant's invoice is furnished on which the unit price of the material has been determined. This road is convinced that this system is more efficient than where pricing is performed by clerical forces. The transfer of this work from office to storeroom has resulted in a reduction of clerical forces in the office without any increase in storeroom forces. The prices are also shown in the stock book,

as this is found necessary on account of the operation of purchase allotment or budget.

Road C Retains Price Book

The pricing on Road C is performed in the storeroom by section stockkeepers and helpers. Prices are placed on the requisitions by these employees at the time the material is issued. For all material stored inside these prices are maintained on bin labels. Outside, the prices are stenciled on each item of material, the prices of smaller items stored outside are maintained in a stock book and orders are priced from this book by stockkeepers and helpers. The price book is maintained in the office and these prices are kept up to date by checking against merchants' invoices when received. Where prices have changed, bin labels are prepared in the office by a stenographer. This road considers that it is reducing clerical work to the minimum. Priced shipping notices are furnished local stores by the division stores, and immediately upon receipt of the material, prices are checked against the bin labels and corrections made where necessary.

Keep Prices in Stock Book

The material issues on Road D are priced at the time material is issued by section stockkeepers and helpers. Prices are recorded on bin cards. This record is maintained by referring to the section stockkeeper, in the case of direct shipments, a copy of the merchant's invoice on which a clerical staff in the office has calculated the unit price of the material. For material received from district or division stores, a copy of the transfer invoice is furnished on which the price is recorded by the stockkeeper of the store shipping the material. This road also shows prices in the stock record so that stockkeepers will have an accurate knowledge of the value of material at the time of ordering stock.

It has been found that much better judgment is used when ordering material if the stockkeeper is aware of the value of the material ordered. A substantial reduction in clerical staff was accomplished when the pricing work was transferred to section stockkeepers, without additional payroll expense in the storeroom. More correct pricing has taken place since this work is performed by employees familiar with the material.

It is recommended that establishing the price of material on the basis of a single piece should be adopted as far as it is practical to do so, having in mind that such a procedure will reduce clerical work in pricing material issues.

The report is signed by E. D. Toye (chairman), general storekeeper, C. N.; C. V. Coulter, district storekeeper, C. C. C. & St. L.; J. J. Kukis, superintendent of stores, Erie; J. E. McMahon, assistant purchasing agent, C. St. P. M. & O.; K. P. Chinn, assistant general storekeeper, S. P.-T. L.; J. W. Gorsuch, general material supervisor, Penn.; H. Shoemaker, storekeeper, B. & O.; R. R. Jackson, division storekeeper, Wabash; J. P. Kavanaugh, general storekeeper, C. & O.; W. M. Hughes, storekeeper, B. R. & P.; and D. C. Curtis (chairman ex-officio), chief purchasing officer, C. M. St. P. & P.

Discussion

E. W. Peterson (Bangor & Aroostook): We apply prices to the material in the yard. In the general store house we have been pricing, but where store delivery is in effect, the user does not get the benefit of the bin price, but he does the unit price on outside material.

C. D. Curtis (C. M. St. P. & P.): It is a difficult matter to advise the using departments continually of prices of material that they use. There are several methods in use that have been tried and discontinued, and others put into effect. There have been stickers put on material sent to the shops with the prices on them. The delivery boys have been advised of the price, wherever they came in contact with them. In the weekly meetings of the foremen in the shop they take up the question of pricing on the different materials, and they are informed of the different prices to put on the material, in their shopping program. The storekeeper is in attendance at these meetings, where they are planning the shopping of their different quipment, and also their work. They also give prices at this particular time. In the working out of the allotment scheme, in asking for money, the roadmaster is informed as to the prices of the frogs and switches, the bridge and building man, the price of lumber, and so on, so that they know the different prices of materials, and how much they are spending. It all depends on the interest taken by the using departments, as to how much benefit you get. Certain foremen and supervisors receive a great deal of benefit and are very much interested in it. With others you have hard work arousing any interest whatsoever, from the point of view of costs, and it is a matter of continual education, and continually devising new means to keep this interest aroused.

Mr. Toye: The committee found, in this campaign, that some roads would attempt to conserve on a particular item—for instance, Stillson wrenches, or shop tools—and in doing so they would tag the individual item so that the user of that particular tool would be advised of its value. At the smaller outside points where shop delivery is not practical, often the issuer of the material is in a position, through this system, of advising the shop employee who accepts the material at the store as to its actual value. Of course, that is limited now that shop delivery is quite general at very small points.

I. C. Morrison (C. B. & Q.): We are all after payroll saving, and I am wondering if the committee can furnish a definite statement as to the cost of pricing material prior to this procedure, or to their change, and the present cost, for comparative purposes.

Mr. Toye: Several members on the committee practice the recommendation of the committee. After the pricing was transferred to the store room, they eventually eliminated the price clerk in the office. Formerly some had two, three, and four price clerks, but now the pricing is carried on by the present staff without any increase.

Mr. Goodloe: I should like to ask the committee if it would maintain a price record as well as pricing items. In the case of an inventory at an outside point, if you do not have price records, how do you get the prices on the inventory?

Mr. Toye: Outside points are handled just the same as district stores.

Mr. Goodloe: Suppose it is at an inspection point where you don't have a store man.

Mr. Toye: That would come under the jurisdiction of the nearest store.

F. C. Newman (Southern): Under Railroad "A," the report says that the price is obtained from a copy of the purchase order. How does the stock man know the amount of freight?

Mr. Toye: The purchase order is referred to the stock man by the office. The purchase order is checked by the office, and any carrying charges are applied to the invoice price showing on the purchase order before it is referred to the stockkeeper.

Mr. Newman: How do they get the amount of the freight charges?

Mr. Toye: The purchase order is not referred to the stockkeeper until the material is received.

M. J. Wise (S. P.): The principle of unit pricing and unit piling of material is fundamentally sound. The best way of knowing what you are doing is by having a good accounting system. Unit piling and unit pricing of materials is one of the best ways we have of getting accurate accounting, and we ought to take advantage of every means at our command to get better accounting on materials.

U. K. Hall (U. P.): Our biggest problem is the control of stock, and having sufficient material on hand with an absolute minimum investment. We should do everything we can to educate our material handlers to control the material, and not try to make accountants out of them. The more they specialize in this one work of control, the more expert they will become. The problem is not particularly to get the most accurate pricing,

although we try to have accurate pricing. Our method of procedure, where we can follow it, is to take a helper, or a bright man in the stores, who has a knowledge of material, and make a price clerk out of him. The best all-'round stores man is a man who has had office experience in a general way, as well as material handling experience, and then office experience.

On approximately a $16,000,000 stock, our inventory shortage for 1927 was only $28,000. We feel that we are getting accurate pricing. It costs us something. We can't do it for nothing.

D. C. Curtis (C. M. St. P. & P.): There is no question but that a man can be a better stockkeeper if he handles the materials on a dollars and cents basis than if he does it on the basis of pieces of material. It is perfectly natural for a man to handle a $50 item differently than he does a two-cent item. If a stockkeeper has no knowledge of values, he is not nearly as good a man as he is if he has a knowledge of values. The greatest good comes from having your pricing men on the section, by educating your own stockkeepers to be businessmen, instead of having strong arms and weak minds.

(*The report was accepted.*)

Report of Joint Committee on Fuel

Savings made in use of coal lauded——Possibility for economy in purchases pointed out

Samuel Porcher
Chairman

Materials and supplies, exclusive of fuel, account for about 19 per cent of railway expenses; fuel alone, about 6½ per cent. The operating revenues of the Class 1 railways of the United States is somewhat over $6,000,000,000 annually; operating expenses about $4,600,000,000. Six and one-half per cent of the latter is more than $400,000,000. The following are railroad fuel figures of 1926 compiled by the fuel department of the American Railway Association:

Fuel Consumption of Class 1 Railroads—Year 1926

Bituminous coal	122,822,853	net tons
Anthracite coal	2,005,403	gross tons
Lignite coal	52,305	net tons
Fuel oil	2,459,677,722	gallons
Wood (hard)	30,581	cords
Wood (soft)	74,240	cords
Other fuels	10,687	net tons

The total is equivalent to nearly 150,000,000 net tons of bituminous coal.

Bituminous coal is much the largest item of the above and fuel oil is next. They cost the railroads about $2.62 per net ton and $2.95 per gallon ($1.24 per bbl.), respectively, considering the invoice price, plus freight charges.

The railroads use about one-fourth of the bituminous coal mined and about one-fifth of the fuel oil produced. They pay annually about $390,000,000 in taxes, $225,000,000 in dividends out of income and about $180,000,000 in dividends out of surplus.

Economical use of fuel is vital not only to the railroads but to industry and manufacturing generally. The National Association of Purchasing Agents gives a great deal of time to fuel. It is continually studying the problems of quality, intrinsic value of different fuels and costs, different grades of coal, and selling prices. In evaluating different coals which are on the market, it has been found that they range from 100 to 60 in their relative values, depending on their content of volatile matter, fixed carbon, ash and fusability, clinker, moisture, rate at which the coal is burned, etc. The National Association of Purchasing Agents keeps a record of bituminous coal consumption for the whole country and publishes that in the form of a chart, which is used as a good index of the condition of manufacturing and railroad business.

The mechanical departments of the railroads handle these features for us and the transportation departments look after the effect that the origin of railroad fuels has upon our traffic and revenues, but the purchasing and stores departments have a place in this work to build up the power of the united railroad profession in its aims of service and stewardship.

Great progress has been made in the efficient use of locomotive fuel in the past decade. The pounds of coal consumed per 1,000 gross ton miles in freight service has decreased from 162 in 1921 to 131 in 1927, and the pounds of coal per passenger train car mile from 17.7 to 15.4, and this decrease has been a steady one from year to year. This decrease should continue. One cent saved on the dollar spent for fuel would increase the net income available for stockholders or for betterments or for the benefit of the public by $4,000,000 annually, or somewhat more than 0.3 per cent. Other striking comparisons might be made and a really fascinating story written about fuel. Division VI has been taken into partnership by railroad managers in watching the use of fuel and controlling its cost.

The report is signed by S. Porcher, retired assistant vice-president, Penna.; Thomas Britt, general fuel agent, C. P.; C. H. Hoinville, asst. to general purchasing agent, A. T. & S. F.; L. N. Hopkins, general purchasing agent, C. B. & Q.; G. E. Scott, purchasing agent, M-K-T; R. C. Vaughan, vice-president, C. N.; W. C. Bower, manager purchases and stores, N. Y. C.

Consignment Stocks---Their Advantages and Limitations

Economies dependent upon quantity, consumption and careful policing——
More clerical work

By C. K. Reasor

Assistant Manager of Store, Erie

C. K. Reasor

So-called consignment stocks of materials are kept to some extent on almost every railroad in the country, and, generally speaking, two or three widely known products are universally handled on a consignment basis.

There are no objections to consignment stocks if they are bought at the lowest price for the kind and quality desired. The same care must be taken in the replenishment of consignment stock, however, as with any other class of material. Unless replenishments are carefully checked, the tendency is to carry a heavier supply to avoid any possible shortages, with the resultant annoyances and delays. Consignment stocks extravagantly ordered are apt to result in extravagant usage and costly losses through obsolescence.

Consignment stocks properly policed under contracts with a reliable firm entered into on a competitive basis will result in economies to both parties.

Concerns supplying consignment stock must keep a careful check of the materials shipped, used, and on hand, to protect themselves in the payments. By means of records of consumption of individual items of material, they are able to forecast the railroad's probable requirements and to have current materials made up in advance of receiving replenishment orders to protect emergencies. The manufacture of such materials on an orderly schedule enables manufacturers to conduct the work efficiently.

Firms which maintain consignment stock have a vital interest in the turnover of these materials and the responsible type of firm can and does offer pertinent suggestions respecting slow moving items. Thus the railroad has the benefit of another check to prevent carrying of material too long.

Consignment stock is not paid for until used and the railroad company is saved the interest on the investment. An offset against this saving is the cost of maintaining somewhat more

detailed records and the additional order or report which it is necessary to keep of material used.

Consignment stocks have their limitations. They are not economical where the class of material involved covers a large number of items, the value of which is relatively small, and where the cost of the extra accounting would offset the interest on the reduction in the investment. They are not practicable where the source of supply is apt to change frequently.

As a whole, consignment stocks properly policed, established with due regard for prices and quality, and limited to classes of material for which they are practicable, will result in substantial benefits and economies.

Report of the Committee on Fire Prevention

Storehouse fires cause over million dollars loss in five-year period——— Book of rules proposed

W. H. Morris
Chairman

A further study of this subject indicates the need for constant supervision as considerable capital is invested in storehouse buildings and in materials, all of which must be safeguarded against loss. Not many buildings can be classed as "fireproof" and few can withstand a severe fire.

Attention is directed to the statistics of fire losses for 1926, including those in storehouse buildings and contents. A marked decrease is noted in the number of fires assigned to stores, although an increase in the number of fires from the following causes, which might occur around stores:

Careless burning of rubbish and material
Explosives.
Fusees.
Gasoline, oils, etc.
Heating appliances.
Smoking.

Railroad Fires

Year	No. Fires		Values	
1923	8395		$ 9,001,122	
1924	8609		10,049,936	
1925	7866		7,397,433	
1926	8388		7,268,435	
Total	33258		$33,716,928	
1923	112	Storehouse Buildings and Contents		$ 867,247
1924	80	" " " "		187,001
1925	71	" " " "		327,860
1926	49	" " " "		21,466
Total	312			$ 1,403,576

*From statistics compiled by the Railway Fire Protection Association.

On one railroad, during a period of three years, there were 19 fires in storehouse buildings, classified as follows:

Type of Buildings:	Causes:
15 Wooden frame.	8 Unknown.
1 Corrugated steel and wooden frame.	2 Flammable material on steam pipes.
1 Old box-car.	4 Overheated stoves or flues.
2 Brick and wooden frame.	2 Defective electric wiring.
	1 Spark from locomotive.
	1 Gas blow-torch.
	1 Thawing out pipe with oil-torch.

Fourteen of the fires started in the storehouse.

The first step in conserving property, is that of fire prevention; the second, fire protection. Both are of equal importance for statistics reveal that a large percentage of fires are preventable, and the balance are due to inherent causes.

To be certain at all times that rules are understood and obeyed, new employees particularly, should become acquainted with the simple rules of fire prevention at once.

The success of fire prevention depends upon the well-organized fire brigade, and the attitude of the men assigned to this work is reflected in the interest taken by the storekeeper, or others in authority.

Handbook of Instructions

Committee has compiled a booklet of instructions and information on this subject, for the use of the members of the fire brigade in the stores and any others interested in, or responsible for the proper safeguarding of the proyerty. It is suggested that the rules included in the report of last year, together with the additional instructions of items listed which are appended to this report, be printed by the association and distributed at a nominal cost to the railroads not having such printed instructions.

Acetylene, Etc.—Cylinders should be stored in dry, well ventilated buildings or compartments of non-combustible construction, only one story, and having no basement and used for no other purpose, as far as practicable. They should be located remote from other buildings or flamable material.

Cylinders are susceptible to mechanical injury and possible explosion and require careful handling. When using a crane-hoist or derrick, the cylinders should be in a cradle or suitable stand and should never be handled by magnets, or with ropes or chain slings.

Acids.—Nitric Acid, mixed sulphuric and nitric acid, and sulphuric acid, frequently cause fire when brought in contact with combustible materials. Water in large quantities should be used to extinguish these fires and should be thrown on the fire from a safe distance. They should not be kept near flammable materials or containers for such materials.

Barrel storage.—When necessary to store barrels of oils, paints, etc., outside, they should be located at least 50 ft. from any other building. A non-combustible shelter or roof over the storage space will eliminate the hazard from sparks; protect them from the sun's rays, and reduce the spread of oil, etc., on surrounding ground. Barrels stored in the open, should not be more than two tiers high and then stored in racks specially built to support them on the side.

Buildings.—Wherever feasible, fire-proof or fire-resisting materials should enter into the construction of all storehouse buildings and equipment. Where it is necessary to house other departments in the same building; fire-wall and doors should separate the storehouse. Proper fire protection should be provided by the use of sprinkler systems, hose-reels, connected to outlets on a fire line, and fire extinguishers, as approved by the National Board of Underwriters.

Oil storage or paint storage rooms at small or sub-stores, can be built as a part of the main building, with fire-wall between, extending from the basement to the roof. Such storage rooms should be only one-story high and a basement should be under the oil or paint storage section only.

Electric lamps in storehouse buildings should be well supported and equipped with substantial wire guards, where subject to mechanical injury or likely to be placed in contact with combustible material. For portable electric lamps, reinforced wire cable must be used and the lamps protected by wire guards. Electric lamps in rooms where flammable vapors are present, should be provided with vapor-proof globes and keyless sockets.

The practice of using abandoned frame buildings, wooden box-car bodies, etc., which are obviously fire hazards, to store material, should be discouraged.

Calcium carbide should not be kept in storehouses with other material. It should be stored in dry, well-ventilated buildings or compartments of non-combustible construction. Calcium carbide itself, does not constitute a fire hazard, but when brought into contact with water, acetylene is generated, which is highly flammable. Therefore the storage buildings should have a conspicuous sign posted on them, reading: "CALCIUM CARBIDE —In Case of Fire, Use no Water."

Exhausted battery elements when wet, heat up and are a constant hazard. They should be kept in a dry, well-ventilated location, away from other material, and completely dried before packed for shipment. The containers in which new elements are received, should be used to ship the exhausted battery elements. The cars in which they are shipped, should be dry.

Fire Protection, Inside.—Automatic sprinklers are recommended for storehouses. Where the effective distribution of water would be more or less reduced, due to the presence of closed shelving, this disadvantage can be overcome by the use of daylight shelving, open type racks and island platforms. The sprinkler system should be supplemented with standpipes with hose connections, and 100 to 150 ft. of hose attached; also an adequate number of approved chemical extinguishers of the 2½-gal. type.

For oil and paint storehouses, the steam-jet fire extinguishing system, manually operated or automatically controlled, is recom-

mended, supplemented by chemical extinguishers of either the foam or tetrachloride type; also pails of sand. Thermostatic alarms can be installed for giving the alarm of fire.

Flammable, Volatile Liquids.—Those commonly used in railroad shops are: Alcohol, wood alcohol, amyl acetate, benzine, benzole, distillate, gasoline, lacquers, naphtha, paint and varnish, paint and varnish remover, turpentine and turpentine substitute.

The main supply should be kept in an underground tank, installed in accordance with Underwriter's requirements. Where supply of one barrel or less is carried, it should be obtained in a metal drum and kept in a detached non-combustible building, at least 50 ft. from all property; building to be kept locked. Signs reading: "Danger, Keep Lights and Fires Away" should be conspicuously posted. Daily local supply must be kept to a minimum, and where practicable, limited to one gallon, and kept in an Underwriter's approved safety can.

Waste paper should be stored in a metal lined bin with self-closing cover; and bin preferably kept outside of main building, or in a separate building; at a point which will not result in an exposure to property. Where paper is baled, bales should be removed frequently and the amount on hand should be kept at a minimum. Care should be taken to remove all oily papers, rags, etc., before baling, to eliminate danger of spontaneous ignition. When shipped to bailing plant, or accumulating point, an assigned car metal lined, or an all-steel car should be used.

Lockers.—The use of wooden lockers or closets for employees' clothing or material, should be discouraged, as they form concealed spaces for the origin of many fires. Substantially constructed metal lockers, with expanded metal or wire doors and sides, should be provided. All lockers should be inspected and cleaned, once each month. Lockers should not be placed in the oil or paint storage buildings or rooms.

Lumber and Crossties should not be piled within 100 ft. of buildings. Surrounding storage ground should be kept free of grass, leaves, etc., and adequate space maintained between piles, to reduce the likelihood of a fire communicating from one pile to another. Crossties temporarily placed along the right-of-way should be stored and piled in accordance with standard methods.

Lumber and Material Yards.—A separate water pipe line system for fire protection should be installed with sufficient fire hydrants, conveniently located. Hose should be located at each hydrant and kept in a small house on a reel. Where the above system cannot be installed, the yard should be equipped with water barrels and metal fire pails distributed properly throughout the area. The barrels and pails should be labeled in ample sized letters "FOR FIRE ONLY." The barrels should be kept completely filled at all times with water, treated to prevent freezing. Salt or Calcium chloride is generally used to prevent freezing. Roadways should be posted with fire signs and kept unobstructed.

Inspection.—A competent storehouse employee should inspect storehouses daily, prior to closing time, to see that the premises are kept clean and free from any cause of fire; also to see that all fire equipment is in proper condition and in its proper place, and that material is not stored to interfere with the proper operation and use of such equipment.

At least once a year, a committee should be appointed to make an inspection of all points, large and small, where material is stored; having corrected as far as practicable, any fire hazards or bad conditions that may be observed, and making a written report of conditions found; calling attention to any important hazards or bad conditions that cannot be corrected at once, with recommendations for betterment. These reports should be kept on file and compared each year.

The report is signed by W. H. Morris (chairman), general storekeeper, Reading; C. A. Marshall, division storekeeper, C. of N. J.; I. G. Morrison, storekeeper, C. B. & Q.; J. L. Quarles, assistant general storekeeper, C. & O.; C. E. Smith, general material supervisor, Penn.; W. L. Wheeler, assistant general storekeeper, C. & N. W.; A. J. Mello, purchasing agent, Pacific Fruit Express; Q. A. Parker, division storekeeper, A. T. & S. F.; and L. Lavoie (chairman ex-officio), general purchasing agent, C. N.

Discussion

Mr. Morris: We should like to have an expression relative to the printing of a small booklet similar to that used by the Pennsylvania and the Chesapeake & Ohio, and a number of the larger roads. They have printed a book having a red cover. The committee would like to know if the member roads of this division would approve of that scheme, and if they feel that it would be useful to their particular organizations. It is evident that if we were to have books like these printed in large quantities, they could be sold for a few cents a copy, whereas if a small road would get a hundred or several hundred copies printed, it would probably cost them considerably more.

Frank McGrath (B. & M.): I should like to see slacked lime studied. We had a fire at one of our storehouses caused by that, and we are not storing slacked lime on that account. It is a source of danger.

O. Nelson (U. P.): Under the heading "Records," the committee states that, "stock books, unpaid invoices, open receiving tallies and important papers, etc., should be kept in metal containers of a size easily handled and stores department employees assigned and made responsible to see that these records are removed to a safe location when an alarm is sounded."

It occurs to me that that is rather a complicated way of handling it, and I should like to suggest to the committee that it incorporate in its report that these records should be kept in fireproof vaults or boxes, as far as possible.

The Chairman: The committee accepts that change. That will make it read "a safe or fireproof vault—."

E. W. Peterson (Bangor & Aroostock): I should like to ask the committee if they have any suggestions to offer in connection with the proper storage of lamp black?

W. Davidson (I. C.): The fire protection rules say that all inflammable materials such as fusses, torpedoes, and lamp black, must be stored in a separate, fireproof building, and only transferred into the stock or storehouses when carried in metal containers and small packages.

(The report was accepted.)

Report on Safety Rules and Practices

H. W. Concannon
Chairman

The committee recommends that corrective action be taken on the infringement of safety rules, regardless of whether or not an accident results.

Bulletin boards, with box attached should be placed in various locations in and around storehouses and grounds for bulletins and safety suggestions, and employees encouraged to offer constructive suggestions.

It is recommended that employment papers be amended by a special blank provided for laborers on roads where application papers are not filled out, to show that instructions and explanations of safety have been given the new employee before he begins work, and that the employee accepts the responsibility.

It is recommended that the form submitted by the 1927 committee be amended as follows:

.... (Place) .... (Date)

.... (Name of party giving instructions) .... (Title)

has this date called my attention to, and given me explanation of instructions in the Safety First Plan and Policy of ———— ———— Railroad, in which all employees are requested to fully co-operate, and I desire to do my full part to help promote Safety First and to use necessary care to prevent accidents to myself and to other employees.

Where new employees do not require physical examination, the employing officer should make a sufficient examination to satisfy himself that they are able-bodied and fit for the duties assigned.

Oil Houses

All oil houses should be protected with signs reading "Open Lights Not Permitted In or Around This Building," and posted at all entrances.

A barrel lifter tool, Fig. 1, is handy around oil houses where large quantities of drum oil, gasoline and distillate are handled. One man, by applying this tool to the rim of a barrel, can easily set a full 100-gal. capacity drum on end.

A special hand truck for use in oil houses for handling barrels of grease, oils and paints, is shown in Fig. 2. The use of this truck not only makes it much safer in handling material of this kind, but a barrel can be handled by one man and when clamped into place is secure.

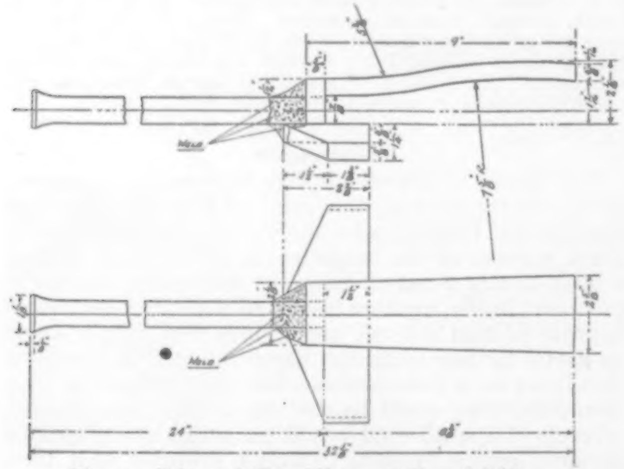


Fig. 1—Side and Top Views of Barrel Lifter

Provisions for Scrap Yards

Gantry Cranes should be equipped with an automatic type bell. The bells should be located on each of the four corners of the crane so that plenty of warning will be given whenever the crane is in motion.

Warning signs should be placed where "skullcrackers" are used and the latter should be roped off where practical.

Truck for Delivering Axles

Carbide cans must be thoroughly cleaned before they are used for shipping material.

Reclaimed high explosive boxes must not be used for shipping material.

Goggles should be properly ventilated and protected by wire screen.

Instructions for Supply Trains

Any unsafe conditions discovered by the crane operator or employee engaged on or about the crane should be reported promptly to the supply train storekeeper, who should make arrangements to have the work done at the nearest shop practicable.

Standard hoist signals should be used as follows:

One blast—Crane operator calls division storekeeper.

Two blasts—Crane operator calls supply train storekeeper.

Succession of short blasts—Alarm.

When the crane is operating, no one shall walk under the magnet.

Pike poles shall be a part of the crane equipment and when necessary they shall be used to guide rail being loaded by magnet. Under no circumstances shall any employee touch rail.

The crane operator will be held responsible for the operation and condition of the crane at all times.

The condition of cable, hooks and other lifting apparatus must be inspected by the mechanical department every thirty days.

The condition of generators, conductor cable and other electrical apparatus must be inspected by the mechanical department every thirty days.

Crank case oil should be changed at the end of each 500 working hours or more frequently if necessary.

The boom must be lowered and properly secured while traveling. The crane must be "spotted" on the end of the car toward the locomotive with the boom toward the caboose.

The crane must be anchored with clamps and chains at each stop, at the end of each day's work, and before starting on "deadhead" runs.

The crane operator must thoroughly familiarize himself with the lifting capacities at various radius, and his judgment will be the deciding factor when questions arise as to whether or not certain lifts should be made.

All necessary precautions must be taken to protect the crane from interference with overhead wire, passing trains, cars on sidings, buildings, etc., at all times, and particularly when distributing and picking up the plates or other material with the train moving at a low rate of speed. In cases where any doubt exists, the crane operator will wait for instructions from the division storekeeper.

Special Truck for Heavy Castings

When necessary to carry the magnet on a car separate from the crane car, these cars should be chained together with standard wrecking chain.

Special Truck for Hauling Tires

The crane must not be operated by other than the crane operator.

Equipment such as fuses, torpedoes, hooks, pike poles, etc., must be on the crane at all times in sufficient quantity to provide safe operation.

The crane must not be operated when working within yard limits until the proper flagging protection has been provided.

The supply train storekeeper in the absence of a regularly assigned operator shall assume full responsibility for handling the crane or arrange for a capable substitute. He shall see that crane is kept in such condition as to present the same neat and

tidy appearance as the balance of the supply train equipment.

All employees must be in the "clear" when the magnet or crane is being operated.

Cars equipped with end doors should also be equipped with aprons and chains, or hand-hold rods; also with car safety coupling chain when operating in the supply train.

Handling Gasoline

For protection against static electricity during the transfer of gasoline from tanks in the supply train, arrangements should be made to weld, either to the tank car body proper or to the

Truck for Handling Barrels

pipe line a single conductor flexible cable not smaller than No. 4 gage. This cable should extend the full length of the hose on either side of the car, and project far enough past the end of the hose in order that a suitable clamp, also welded to cable, can be clamped to the intake pipe of the ground storage tank, and in this manner form a perfect ground from the car to tank prior to inserting the nozzle of the hose into the intake pipe of the underground storage tank.

If a pinch type clamp is used, the jaws should contain teeth, also a spring tension, which will be strong enough to hold it to the intake pipe while the operation of discharging gasoline is in progress.

Safety Devices for Material

In connection with its report the committee presented illustrations and brief descriptions of 12 devices for handling material which were recommended for their safety as well as their usefulness. The list comprises:—

A clamp for handling locomotive driving boxes by hoist. (Fig. 3.)

A clamp for handling axles by hoist.

An attachment to a warehouse type truck for moving tires.

A hook for handling driver springs by hoist.

A two-wheeled truck for moving axles and heavy castings. (Fig. 4.)

A warehouse truck equipped to carry tanks of oxygen.

A warehouse truck equipped to carry tanks of acetylene.

A clamp for handling frogs by crane.

A cradle for handling 100 brake beams by crane.

A truck for moving driving boxes. (Fig. 5.)

A truck for moving tires. (Fig. 6.)

A clamp for handling sheet metal.

The committee recommends that the 1927-28 report be put up in pamphlet form, and all railroads furnished with sufficient copies for distribution and that district and division storekeepers render, for comparative purposes, a report monthly to the general storekeeper of the total number of accidents in the stores department, regardless of the nature or extent.

The report is signed by H. W. Concannon (chairman), district storekeeper, S. P.; W. H. Merritt, traveling storekeeper, B. & M.; H. C. Ralls, district storekeeper, M. P.; N. Feigel, storekeeper, S. P-T. L.; H. C. Ray, reporting storekeeper, Penn.; J. L. Berryhill, general storekeeper, W. P.; F. A. Murphy, district storekeeper, B. & O.; G. W. Hanegan, general storekeeper, M. & St. L.; C. C. Dibble (chairman ex-officio) general supervisor of stores, N. Y. C.

Special Tongs for Hoisting Driving Boxes

Discussion

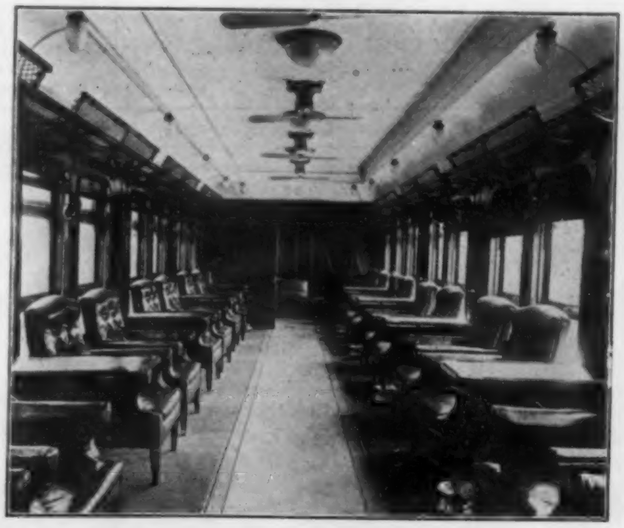
Will Morris (Penna.): On Page 9, almost the last line, it says such reports are made for comparative purposes. I would suggest that that be made to read "for corrective purposes."

J. T. Goodloe (Southern): On Page 3, the committee recommends a hand truck for hauling oil barrels. We handle our oil barrels by rolling them. We do not see the advantage of a truck where you have concrete roads, and car-level platforms. You can roll it about as well as you can truck it.

Mr. Congannon: It is safer to handle oil barrels of certain dimensions and carrying certain commodities on a truck, because they are clamped on as soon as they are loaded on the freight car.

The report was accepted as read.

* * *



A Parlor Car on the Buenos Aires Southern (South America)

Report on Equipment Buying and Large Contracts

Committee would bring all under review of purchasing agent—— Check prices of parts when buying complete unit

J. L. Bennett
Chairman

Railroads through the various departments conclude contracts for projects of many kinds. In many of such contracts the railroad indirectly becomes a purchaser of materials. Therefore, the purchasing agent should have the opportunity to pass upon a contract in which material is involved. The purchasing agent knows the condition of the market and is capable of criticizing any prices for materials which may be enumerated in the proposed contract, or it may be possible to have the purchase agreement provide for the use of supplies secured through existing purchase agreements. Furthermore, the purchasing department should have the opportunity to voice its opinion when the form of an equipment contract is drafted. Particularly should the purchasing agent see that the contract is worded in such a way that the railroad is not under the necessity of accepting materials which may be left over after the completion of the work.

Large Machinery and Contracts

The committee realizes that because of the complexity and variety of machine tools, it is difficult for purchasing departments or machine tool committees to properly analyze bids unless they are uniform. Inquiries should be prepared so as to describe carefully and accurately the equipment desired and leave the least possible room for doubt on the part of the bidder.

It is suggested the standard price inquiry form be employed with instruction to bidders along the lines shown in Figure A, together with a bidding form shown in Figure B. It is desirable that the form be prepared on standard size paper to facilitate filing and so that it can be mimeographed, hectographed or multigraphed. It is suggested that but one tool or piece of machinery occupy each sheet and a description of the tool be written on Form B, when sending out the inquiry. Experience indicates that manufacturers will submit catalogues or additional descriptive data with their bids and the main idea is to obligate the bidder to separate his price so that an intelligent comparison of motor prices, attachments, etc., can be made with other bids.

Exhibit A
Instructions to Bidders

Please quote on machine tools as described on the attached forms separating your prices as required, indicating specifically point of shipment. Your proposition should cover first class machinery suitable for railroad shop work as provided by the enclosed specifications. All bids should be complete, covering full equipment as considered necessary for the kind or class of work to be performed by the machine and to be accompanied by photograph or descriptive cut of the machine offered.

Quotation should include all information pertaining to dimensions of essential and important bearings.

If motor drive, specific reference should be made as to whether you offer machine with drive through belt, silent chain or gears.

Quotation should cover make (if not specified), type (if not specified), horse power (if not specified) and speed of motor and complete information to be furnished as to style and type of control for motor.

Individual propositions must be submitted on each item in the manner designated and item numbers shown.

Price Lists

In the interest of proper analysis, it is also suggested that bidders submit simultaneously with bids on large tools or machinery, a list of the prices for common repair parts, since it has been experienced that high prices for replacing items often offset an otherwise low cost for the equipment.

It is also suggested for the convenience of the bidder, where machine tool lists involve a number of items, that a minimum of two weeks be allowed in which to prepare and submit bids. This is necessary in the case of machine tool agencies who handle more than one line and have to correspond with their constituents at distant points for the necessary data.

The report is signed by: J. L. Bennett (chairman), purchasing agent, C. of Ga.; J. H. Beggs, purchasing agent, C. & E. I.; J. R. Haynes, asst. purchasing agent, C. B. & Q.; E. A. Clifford, general purchasing agent, C. & N. W.; W. W. Morris, asst. to general purchasing agent, Penn.; H. M. Rainie, asst. purchasing agent, B. & M.; T. H. Ryan, asst. purchasing agent, Wab.; G. H. Walder, purchasing agent, C. M. St. P. & P.; E. N. Bender, general purchasing agent, C. F.; A. V. B. Gilbert, purchasing agent, A. B. & C.; E. G. Walker, asst. general purchasing agent, A. T. & S. F.; G. E. Scott (chairman ex-officio), purchasing agent, M.-K.-T.

Discussion

D. V. Fraser (M. K. T.): This is the first time in the history of this committee that anything has been said about a proper form for large machinery and large tool contracts, and as the committee has only suggested the form, as a helpful suggestion, I think it has made quite a step forward, and I am heartily in favor of the formula it recommends.

Item 12 48 in. by 16 ft. Engine Lathe DESCRIPTION OF MACHINE	Base Price and F. O. B. Point (excluding motors and starting equip.)	Motor and Control Price	Extra Attachments Price	Total Price	Total Net and Shipping Weight
1—48 in. by 16 ft. Engine Lathe, Standard Pattern, 8 ft. between centers, 50 in. swing over ways, 35 in. swing over carriage; triple geared; internal gear face plate drive. All steel gears throughout except internal face plate gear which is semi-steel, etc...	$8,000.00 f. o. b. destination	....	....	....	Net Weight 24,750 lb. Shipping Weight 25,000 lb.
30 HP Slip Ring Motor, 900 RPM with reversible drum type controller and magnetic protective panel....................	....	$800.00	....	....	....
2½ HP Traverse Motor 1200 RPM with non-reversing Push Button Starter.......	....	100.00	....	....	....
36 in. 4 jaw independent steel chuck fitted to face plate..........................	....	....	$400.00	....	....
TO BE SHIPPED FROM				$9,300	

Exhibit B—Form of Obtaining Bids on Machinery

L. F. Duvall (A. C. L.): There ought to be some mention of the plans for machinery foundations. The people usually furnish plans for the foundation of the machine.

Mr. Bennett: That is generally customary on contracts of that kind. There is no objection to it. This is merely a suggested basis on which the experience of any particular road can be added to or taken from, as might be necessary. It would be hard to outline a plan that would be acceptable to everybody.

W. W. Morris (Penna.): The idea is not that the form shall be fixed in any way whatever. Behind it lies the thought that you will have every bidder answer the same questions. You can ask those questions in any form whatsoever. In other words, if you have a blind bid, it will be answered in as many ways as you have bids.

F. H. Fechtig (A. C. L.): On the Atlantic Coast Line all of the purchasing of equipment and machinery is conducted through the purchasing department. In asking for the prices, we are glad to have the machinery men quote us on anything that they like to quote on, in addition to what we have asked for, so that if there is anything new our mechanical people will find it out. I think the report of the committee is very good.

A. N. Laret (St. L. S. F.): As Mr. Fraser just stated, this is the first time we have ever had anything in connection with machinery. Anyone who has had any experience in buying machinery knows that this is an essential thing to have. It gives you something with which to work.

The report was accepted as read, without further discussion.

[Following the presentation of the reports of the committees on Resolutions, and Memorials, and the election of officers, the convention adjourned sine die.]

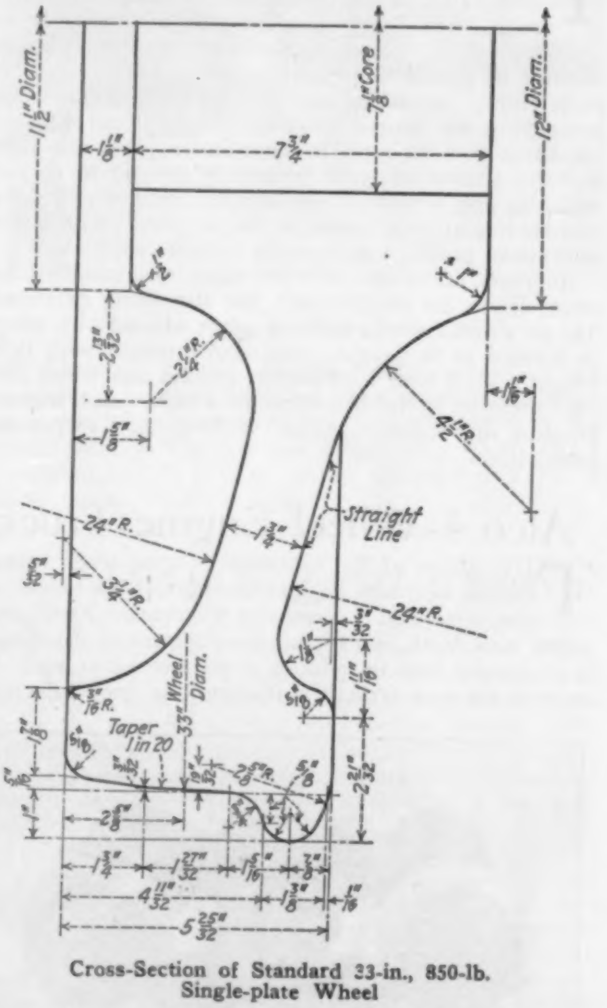
A Switcher and Part of Crew on the C. B. & Q.

New Devices

Single-Plate Wheel with Chilled Tread and Flange

THE Association of Manufacturers of Chilled Car Wheels, 1847 McCormick building, Chicago, is composed of 24 companies operating 56 foundries located in 24 states and four provinces in the United States and Canada. All of the manufacturers of chilled car wheels in the United States and Canada are members of the association and manufacture wheels in line with specifications for foundry standards, inspection and tests as adopted by the association in June, 1927, with the exception of the few wheel foundries operated by railroads.

The single-plate wheel with chilled tread and flange



Cross-Section of Standard 33-in., 850-lb. Single-plate Wheel

developed as recommended to the American Railway Association by the Association of Manufacturers of Chilled Car Wheels was brought out over four years ago. The design was recommended only after exhaustive laboratory, foundry and service tests. Prior to offering the single plate design to the railroads and its adoption by the association, hundreds of tests were made on wheels by the members of the association, and it is claimed that the single-plate design was found to be

superior to the arch type double-plate wheel. Especially was this true of results obtained in the thermal test.

The single-plate design of chilled-tread wheel lends itself to a program of heating, cooling, expansion and contraction, such as may be occasioned when the wheels are overheated and abused by stuck and dragging brakes. The new single-plate design retains all of the desirable features of the double-plate wheel, such as a hard, non-flowing, wear-resisting hub, this latter facilitating hub-boring and a perfect axle fit.

The single-plate design has not increased the weights, which remain as called for by the A. R. A. standard: 650-lb. wheel for 30-ton cars; 700-lb. wheel for 40-ton cars; 750-lb. wheel for 50-ton cars, and 850-lb. wheel for 75-ton cars.

Single-plate chilled car wheels are being exhibited by the association.

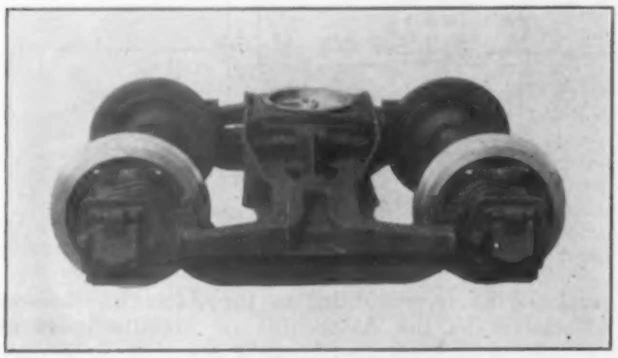
Refinements in Compressors

THE Westinghouse Air Brake Company, Wilmerding, Pa., is exhibiting individually-cast piston rings, now being supplied for all steam-driven air compressors, in accordance with the most modern practice in piston ring manufacture. These rings are made from a special mixture of high grade metal which gives them the desired wearing and frictional qualities consistent with the metal in the cylinders; they also have uniform tension and are accurately ground to correct thickness and turned on the outside diameter to form a true bearing at every point on the periphery, with a predetermined pressure against the cylinder wall.

Improved air valves and valve cages, now standard for steam-driven air compressors, are also being exhibited. The air valves are of a superior grade of steel with wings so formed as to provide maximum strength with light weight. They have a spherically-ground seat which permits them to be readily fitted to a tight joint without grinding in. Valve cages are made of steel to provide longer life.

Alco 4-Wheel Engine Truck

THE design of the four-wheel engine truck having outside bearings, which is included in the exhibit of the American Locomotive Company, 30 Church street, New York, is a further development of the inside-bearing type first introduced about five years ago. It employs the same structural features, the chief difference



The Alco Four-wheel Outside-bearing Engine Truck

being that the side-frame members which house the journal boxes are located outside of the wheels instead of inside. The bolster is extended to overlap the side frames, and the same wearing shoes are interposed between the bolster and the side frames. The same long, easy-riding springs are employed, which also serve the purpose of equalizers. The geared roller centering device, is the same except that it has been improved to provide means for taking up wear.

The wide journal centers have less added load when the truck swings over to pass curves. By maintaining the A. R. A. center dimension, standard axle forgings, brasses, wedges and journal-box lids are used. The design is extremely simple, with few parts, and with bolted fastenings practically eliminated. Ample clearance is provided for cylinder cocks and rigging. The truck lends itself readily to the application of a truck brake, if desired. On locomotives with large driving wheels, there is room for the application of alligator crosshead guides. Alco hub liners are included for taking up lateral play and retarding the flange cutting. These liners may be renewed and replaced while the truck is under the engine.

Truck and Trailer Cellar

THE Ardco Manufacturing Company, One Newark street, Hoboken, N. J., is exhibiting an engine-truck and trailer cellar designed to give a uniform distribution of oil over the surface of the journal. Referring to the illustration, oil is fed by gravity from the oil cup through a flexible metal hose which is connected to a circular passage in the front of the cellar. This passage communicates with two channels, one on each side of the cellar. The channels are shaped to hold absorbent woolen pads which serve to retard the flow of oil and to keep the dirt from clogging up the channels. These pads are held in place by zig-zag springs. The pads and springs are set deep enough in the recess of the channels to prevent them from touching the journal and the pads from becoming glazed.

The hub oiling feature consists of a roller held in a carrier which project through the end of the cellar and is

The Ardco Engine Truck and Trailer Cellar Box

pressed outwardly toward the wheel hub by springs on the guide rods. These rods are also designed to act as packing agitators through their reciprocating action caused by the lateral motion of the wheel. The roller is constantly in contact with the oily packing inside the cellar and the wheel hub on the ouside. Rotation of this roller caused by the revolving wheel, carries lubrication to the hub.

Rail and Flange Oiler

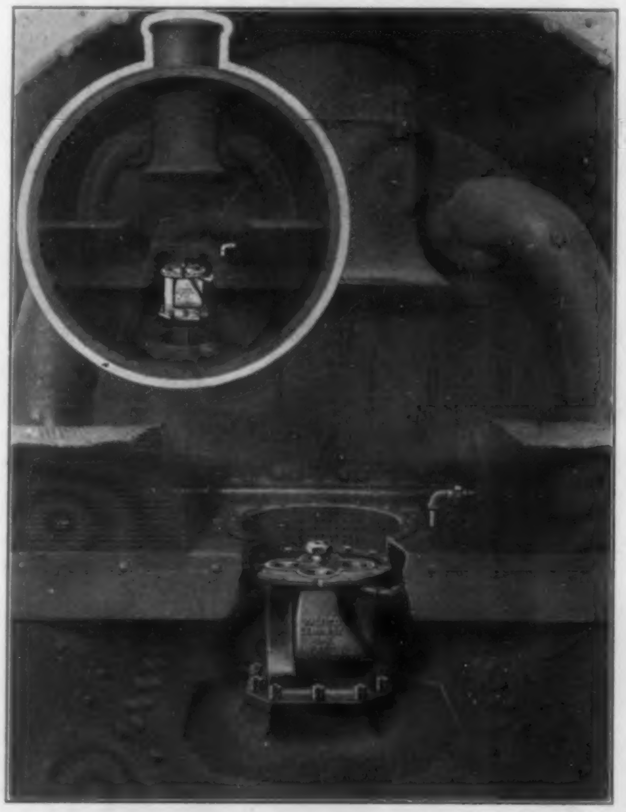
THE Ohio Injector Company, 53 West Jackson boulevard, Chicago, is exhibiting an automatic rail and flange oiler designed to apply a heavy coating of asphaltum oil to the inner side of the outside rail on curved track, and also to the flanges of all cars in the train. This is done automatically, a reservoir of 10 gallons capacity being provided for the oil supply.

The device is mounted on the locomotive, and the oil is delivered to the leading wheel of the leading tender truck on curves only.

The Viloco Locomotive Exhaust Pipe

AN exhaust pipe which is a departure from the usual single opening exhaust pipe is being exhibited by the Viloco Railway Equipment Company, 14 East Jackson boulevard, Chicago.

This exhaust pipe is provided with a partition through-



The Exhaust Pipe in Place in the Front End of a Locomotive

out its entire length which prevents the exhaust steam from one cylinder crossing over into the other cylinder, as is the case with the single-opening exhaust pipe employing a low diverting bridge. This feature is claimed to reduce the mean back pressure, with a resultant increase of power for the locomotive, especially at the top and bottom quarters.

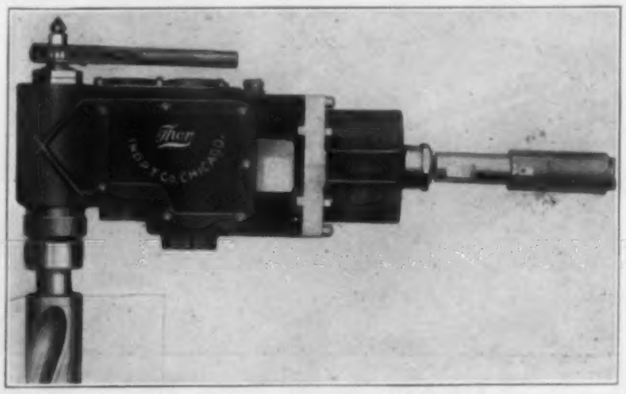
The total exhaust openings of the exhaust pipe are considerably greater in area than that of the single opening exhaust pipe. The exhaust is divided into four streams which permits more entraining area for the smokebox gases. This method of dividing the exhaust is claimed to permit the use of a larger stack since the exhaust steam spreads to a greater area, increasing the front-end draft.

The exhaust pipe is made to fit any cylinder saddle connection which may be employed. It reduces the number of joints and eliminates the use of a separate tip and its joint.

Special Close-Corner Air Drill

A POWERFUL close-corner air drill, known as the Thor No. 9 special, has been placed on the market recently by the Independent Pneumatic Tool Company, 600 West Jackson boulevard, Chicago. It is intended especially for the requirements of heavier railroad shop work necessitating larger drills and reamers.

In designing this new drill, it is said that all of the original, valuable features of the Thor No. 9 drill have



Thor No. 9 Special Close-corner Drill

been retained. In addition, the Special develops more horsepower, owing to increased piston displacement, having a maximum torque 25 per cent greater than the regular No. 9. The new tool weighs only 42 lb., has a free speed of 190 r. p. m. and is equipped with No. 4 Morse taper.

The Morton Suggestion System

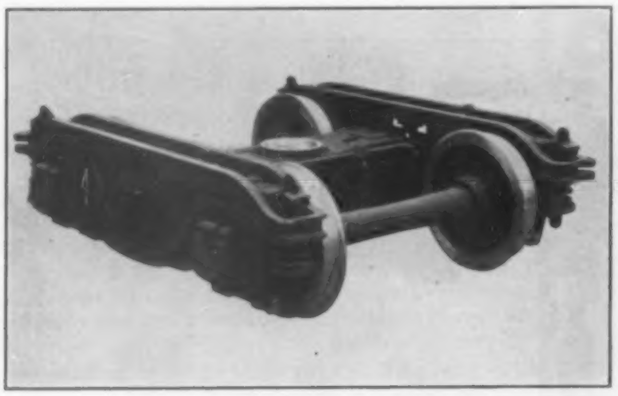
ONE of the exhibits at the booths of the Morton Manufacturing Company, 35 East Wacker Drive, Chicago, Ill., is a cabinet used in connection with a suggestion system which has been in successful operation in the factories of that company for several years. This system was developed by Charles D. Morton, secretary of the company in an attempt to stimulate interest among the employees in the welfare of the company, and to develop loyalty and stability of employment.

The plan of the suggestion system consists essentially of a series of posters, designed to guide or direct the thoughts of the employees along specific constructive channels which are posted each week. Each employee is provided with a blank book, each blank having a perforated detachable stub bearing a number which corresponds with the number on the suggestion blank. The person offering a suggestion is instructed not to sign his name or in any way to disclose his identity. He tears off the stub, keeps it and deposits his suggestion in the cabinet. The suggestions are collected each week and passed on by a committee to determine whether or not the suggestions are practical and usable, whether or not the company wishes to adopt the idea and put it into effect, and if so the amount of the reward to be paid to the suggestor. The thought-directing posters are

changed each week, new messages, which are allowed to remain in place until the following Saturday evening, being posted before the plant opens on Monday morning. The cabinet is made of fabricated steel.

Alco Cast-Steel Tender Truck

THE four-wheel equalized tender truck, which is included in the exhibit of the American Locomotive Company, 30 Church street, New York, is made up entirely of steel castings and the frame elements are not rigidly joined. The open-top, box-like transom overlaps the side frames and is prevented from disengagement by a filling block bolted in the top of the side frames. The bolster, of conventional design but somewhat shorter in length than ordinarily used, has curved roller seats on its under side which mesh with the rollers on which it rests. Similar curved roller seats on the bottom surface of the transom receive the load from the rollers, and a total of two inches of side movement is provided for the bolster with increasing lateral resistance.



The Alco Cast-steel Tender Truck

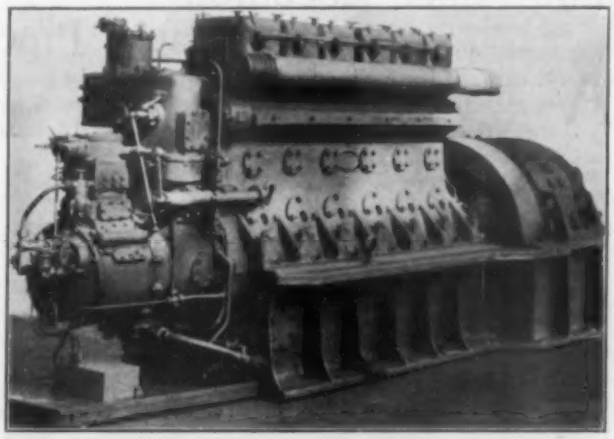
The pedestal faces are provided with wearing plates and semi-elliptic springs rest on top of the journal boxes. Their inner ends are connected through hangers to the ends of an equalizer. The use of coil springs on the end hangers is optional, but when included, they promote easy riding. Spacing blocks, which also form wearing shoes, are interposed between the sides of the bolster and the transom. Fitting in openings in the sides of the transom, they are held in place by the bolster, with no other means of attachment. The simplicity of the construction, the absence of bolted fastenings and its strength without excessive weight are intended to insure long life with low maintenance.

Oil-Electric Unit for Rail Cars and Locomotives

THE Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is exhibiting a new oil-electric power unit for self-propelled rail cars and for locomotives. The unit consists of a six-cylinder, vertical, single-acting, four-cycle, solid-injection, Westinghouse-Beardmore Diesel engine direct-connected to a Westinghouse 600-volt rail-car generator.

This engine which was originally developed for aircraft service, has been modified and improved for railroad service until it now forms an advanced design of light-weight oil engine available for rail application. The cylinders are 8-¼ in. bore with a 12-in. stroke. The engine operates over a variable speed range of from 300 r. p. m. to 800 r. p. m., developing 330-hp. at the latter speed. Including the generator, the unit is about 15 ft. long, 4-½ ft. wide and 5.7 in. above the floor line. The combined weight of the engine, flywheel and bedplate exclusive of the generator, is approximately 10,000 lb.

Two of these units are supplying motive power on an 87-ton locomotive recently delivered to the Long Island Railroad. Engines of this design have been in service on the Canadian National which is now operating 14 combination passenger and baggage cars with Beardmore oil-electric equipment. The first of these cars was placed in service in September, 1925, and to date has made close to a million miles.



Westinghouse-Beardmore Oil-engine-generator Set for Rail Cars and Locomotives

A comparison of operating records shows a saving of 73 cents per train-mile over steam operation in similar service. This comparison was made with two cars aggregating 700 miles daily.

Westinghouse oil-electric equipment is available for 330 and 660-hp. rail cars and for 330-hp. 60-ton and 660-hp. 100-ton locomotives.

New Invention to Stop Corrosion

A PROCESS developed for the prevention of pitting, grooving and all forms of boiler corrosion by using an electric current and arsenic is being shown on the Pier by the Electro-Chemical Engineering Corporation, 621-631 South Kolmar avenue, Chicago, recently incorporated and exhibiting at the Pier for the first time. It is known as the Gunderson process.

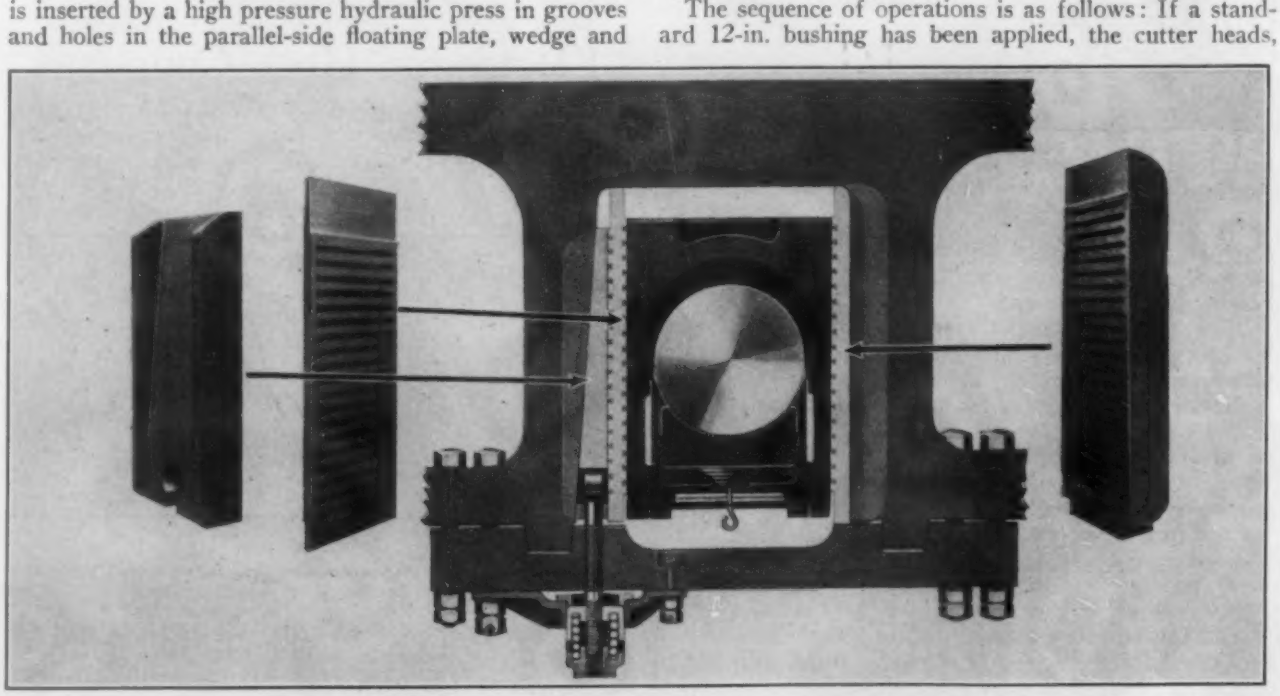
The uniqueness of the process lies in the shunting of a small current of electricity from the headlight generator or a battery to anode pipes located in the boiler water and insulated from the boiler. An arsenic compound is added to the boiler water and the electric current functions to plate a thin coating of arsenic over the boiler interior and then maintain a plating of hydrogen on the arsenic. The arsenic and hydrogen plating is intended to stop corrosion caused by galvanic action, and the counter current, besides maintaining the plating, is claimed to inhibit corrosion due to stray or thermal generated electrical currents.

L. O. Gunderson, president of the corporation, was inspector of water treatment on the Wabash from 1920 to 1922 and from 1922 to 1928 was chemical engineer of the Chicago & Alton. O. W. Carrick, secretary, was with the Wabash as inspector of water treatment from 1917 to 1919; as special inspector, 1919 to 1920, and as water engineer, from 1920 to 1928. They are developers of the method which is now in use or trial on five different railways, one of which is adopting it as standard.

Automatic Driving Box Wedge Permanently Lubricated

THE automatic adjustable driving box wedge, which is included in the exhibit of the Franklin Railway Supply Company, New York, has been redesigned to include means of permanent lubrication.

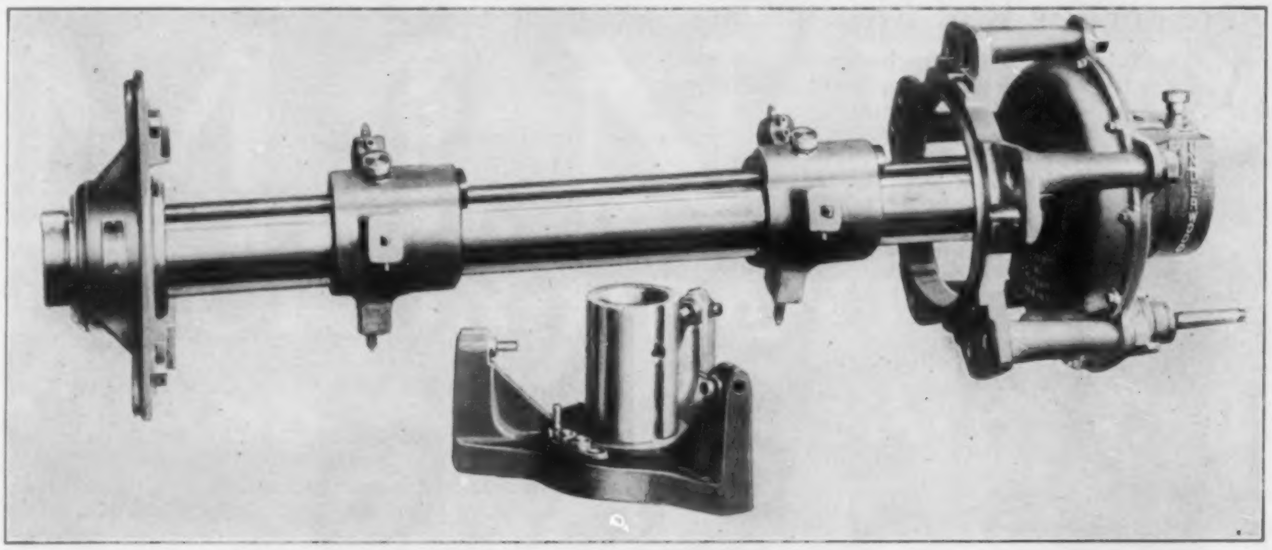
Lubrite, a material having a low co-efficient of friction, is inserted by a high pressure hydraulic press in grooves and holes in the parallel-side floating plate, wedge and shoe. All the wearing surfaces are provided with a lubricant having a practically constant co-efficient of friction. This condition is assured during the life of the parts so that the proper spring tension can be readily attained and maintained. Adjustment is required at intervals only, to care for wear as it occurs.



The Franklin Automatic Driving Box Wedge in Which the Floating Plate, Wedge and Shoe Is Permanently Lubricated

Redesigned Valve Chamber Boring Bar

THE illustration shows a tool designed by the H. B. Underwood Corporation, 1015-1025 Hamilton street, Philadelphia, Pa., for reboring the valve chamber bushings on locomotives, which is among the portable tools being exhibited by this company. This equipment can be operated with an air or electric motor.



The Underwood Valve Chamber Boring Bar

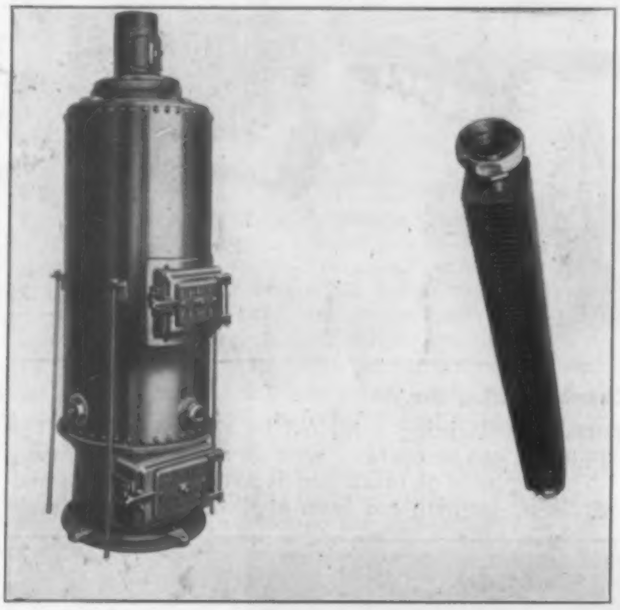
The sequence of operations is as follows: If a standard 12-in. bushing has been applied, the cutter heads,

each having three tools, are removed from the bar, and the tools set to the 12-in. sizers that are applied in 1, 2 and 3 slots in the setting head. One cutterhead is placed on the bar, the bar is then raised by a sling attached between the supports of the driving head and the centering head placed in the valve chamber. The other head is placed in the center of the cylinder between the two bushings and the bar pushed into it and through. The half feed nuts are placed in position when the heads are set at the two starting points.

The thumb screws are tightened down, and the back center head and the bearing are placed on the bar. The three nuts are then tightened on the front centering head, and three nuts applied on the back centering head and support with the bearing. The equipment is then ready to apply the driving motor.

Heater for Rail Motor Cars

A STEEL-jacketed hot-water heater for rail motor cars is being exhibited by the Vapor Car Heating Company, Railway Exchange, Chicago. The heater is designed for the efficient combustion of either hard or



Left: Steel Jacket Hot-Water Heater for Rail Motor Cars—Right: A Section of the Vulcan Fin-Type Surface Radiation

soft coal. It is equipped with a safety fire door and damper lock to prevent any danger of fire getting out of the heater in case of accident.

The Vulcan fin-type, or extended-surface radiation is used with this heater for the purpose of reducing weight. One lineal foot of fin type radiation is equivalent in heating efficiency to more than 4 ft. of 1½-in. standard pipe.

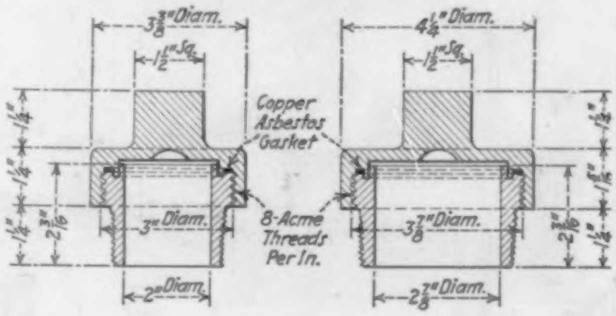
The reduction in the amount of water carried as the result of the reduced lineal feet of piping required with the fin type radiation, produces a quicker circulation of hot water through the radiating pipes, and a much higher temperature of the water at its return to the heater. It is claimed that a saving of fuel is accomplished, as the warmer water returned to the heater will be more readily heated and recirculated through the car.

The Vulcan fin-type radiation is supplied in sections of any desired length up to 12 ft. and is fitted with special unions, or brazed nipples when desired, for pipe connections. It is made in two sizes: 1½-in. O. D. steel tubing with square fins 3¼ in. in diameter for connecting to 1¼-in. pipe, and 2¼-in. O. D. steel tubing with 4¼-in. square fins for 2-in. connections.

In addition to its use on rail motor cars, it has been applied to cars fitted with the thermostatic-control vapor system. It is also used in cooling the engine compartments of rail motor cars and electric locomotives.

Boiler Wash-out and Arch-Tube Plugs

INCLUDED in the exhibit of the T-Z Railway Equipment Company, 14 East Jackson boulevard, Chicago, are wash-out and arch-tube plugs made of drop forgings. The bodies of these plugs are designed with projecting lips to absorb all the abuse from cleaning rods

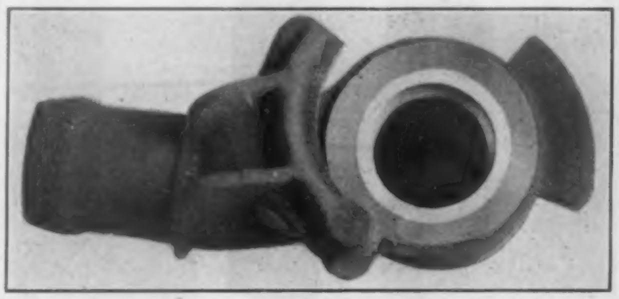


Two Sizes of the T-Z Boiler Wash-out and Arch-tube Plugs

and wash-out nozzles and to protect the seat from becoming damaged. The joint between the nipple and cap is sealed by a special copper-asbestos gasket. The nipples and caps have Acme threads (eight per inch) which eliminates the possibility of the threads crowding and permits of quick and easy removal of the caps. The caps are also provided with 1½-in. square heads to facilitate their removal. The plugs are made in three sizes; namely, 2 in., 2⅞ in. and 3¼ in.

Electro-tite Hose Couplings

THE Westinghouse Air Brake Company, Wilmerding, Pa., is now furnishing hose couplings, called "Electro-tite," which have the gasket groove electro-plated with a special non-rust coating. This pre-



A New Westinghouse Hose Coupling in which the Gasket Groove Is Specially Electro-plated

vents leakage of air past the gasket and lengthens the life of the coupling. The effectiveness of this preventive method is being demonstrated in the Westinghouse exhibit.